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## A LUMINOUS EXTENSION AT THE TERMINATOR OF MARS.

By G. VAN BIESBROECK.

In the evening of Oct. 27, under fine atmospheric conditions, the 40-inch telescope was turned on Mars near the meridian, and at once a curious appearance was noted on the terminator. The accompanying sketch, Plate XXVIII, shows the general aspect of the planet. The drawing was made around $14^h\ 15^m$ G. M. T., at which time the central meridian was at 171°.4 longitude. The dominant dark band is Mare Sirenum, branching to the left towards the Solis Lacus which has just passed out of sight, while toward the right the dark belt is continued by Mare Cimmerium. Farther south the irregular contour of Mare Chronium forms roughly a second dark belt, above which Thyle I and II appear as brighter areas extending to high latitudes not far from the polar cap. The diameter of the latter was measured as 1″.14, which corresponds to 520 km (327 miles). The northern hemisphere has no prominent dark markings in this longitude. Trivium Charontis begins to show on the morning side; a couple of hours later it stood near the central meridian, followed by Cerberus, the two being almost equally dark. Just below and a little preceding Titanum Sinus there was a brilliant spot about the same size as the polar cap, but not quite as luminous. A little north of this comes a faint belt of mottled gray patches corresponding to the location of Nodus Gordii, Lucus Maricae, Ammonium, etc., but at no time was there the slightest impression of anything like the sharp circular notches (lakes), and very much less of the thread-like geometric canals with which this and other regions of the planet have been abundantly covered by certain observers. The same conclusion was repeatedly arrived at during this whole opposition, at each opportunity that I got of examining the planet under good conditions. On the present night the seeing was very nearly perfect for several hours and faint close double stars of less than 0″.3 separation were readily measured at the same altitude as Mars, which could be advantageously examined with a power of 750.

However, the object of this note is to describe more especially the curious appendage to the terminator which I had already noticed at the first glance at the planet ($13^h\ 55^m$ G. M. T.). Starting from a point about 5° south of the Martian equator the terminator loses its normal elliptic shape and bulges out into the shadow-side of the planet; this extension stretches southward over 3″.5 or 1600 km and at about half

of its length it gradually separates from the normal terminator; the southern end is a cusp separated by 0″.5 from the terminator and the space between the latter and the cusp appears as dark as the shadow-side of the planet. The luminous extension itself was not very brilliant, although projected on black background; it seemed to have the same dull steel gray color as that of the adjacent Mare. The whole appearance was quite striking and several colleague observers, who were called in, checked its presence independently. The observing conditions staying highly satisfactory, a careful watch was kept on the object. From its location it was found that it roughly extended along the meridian of 250°, from latitude —5° to —32°, beginning therefore at the northern part of Ethiopis, stretching across Hesperia and Mare Tyrrhenum as far south as Ausonia. As time went on the extension even increased in length and reached a maximum about $15^h$; at $15^h\,05^m$ the elevation above the terminator was measured as 0″.55, and the whole length 4″.06, or 1870 km. At that time the luminous appendage, slightly curved like the terminator, was entirely detached from the latter except for a tiny isthmus at the north end; its shape reminded me of the appearance of some low flat prominences. At the same time there was a suspicion that the object had shifted bodily to the south. This was confirmed by micrometric measures on the estimated middle point:

| Greenwich Mean Time | | Mean Latitude | Length | | |
|---|---|---|---|---|---|
| | | | in arc | in km | in miles |
| h | m | ° | ″ | | |
| 14 | 15 | —18 | 3.50 | 1610 | 1010 |
| 15 | 5 | —19 | 4.06 | 1870 | 1170 |
| 15 | 50 | —22 | 3.07 | 1410 | 880 |
| 16 | 10 | —25 | 2.30 | 1060 | 660 |
| 16 | 30 | —27 | 1.5 | 690 | 430 |
| 16 | 50 | | last impression. | | |
| 17 | 0 | | gone. | | |

The further development is illustrated by the four small drawings representing successive appearances of the same luminous appendage. It became narrower and shorter after $16^h$. At $16^h\,30^m$ the separation from the terminator was no longer clearly visible; the planet was then two and one-half hours west of the meridian and the low altitude began to affect the seeing. However, the bulging out of the terminator was still quite plain but it was evidently on the wane. A last impression of a small elevation over the terminator was obtained at $16^h\,50^m$. At $17^h\,00^m$ the terminator appeared again normal, but the low altitude of the planet made the observation difficult. The next night, Oct. 28, conditions were not so favorable anymore, yet good enough for making sure that the same appearance did not recur after one rotation.

There are on record a number of similar luminous appearances at the terminator at previous oppositions: Lowell in "Mars and its Canals," p. 101, gives a vivid description of the one of May 25, 1903, which he considered as one of the most remarkable. The present one is a still

more striking one, both by its size and especially by its extraordinary persistence during three hours from the beginning of the observations, at which moment it was already fully developed.

Lowell interprets the phenomenon as a cloud of sand-dust, led into this explanation by the ochre color of the cloud as seen beyond the terminator. I did not have the impression of such a color on this occasion, although under the fine conditions of that night the rich variety of colors of the disc came out very beautifully. I interpret the phenomenon as an extended high cloud or fog, illuminated in the morning sky before the subjacent territory is fully brightened up and dissipating under the heat of the sun as it moves into daylight. This might account for the separation between cloud and terminator. It would, however, require a fog of very great extent over the night-side of the planet, namely from about 250° to 290° in longitude; in latitude I assume the cloud to extend in an oblique line from —18° to —27°, so that, as the rotation brings in successive parts of the fog, the front of which melts away in sunlight, the luminous part at the terminator gradually shifts to the south.

Whatever the interpretation of the phenomenon, I thought it worth while recording it at once, in the hope that further information will have been obtained by observers in other localities.

Williams Bay, Wisconsin, Oct. 29, 1924.

## CALCULATIONS OF THE HEIGHTS OF METEORS OBSERVED BY H. L. ALDEN AND C. P. OLIVIER.

By CHARLES P. OLIVIER.

Advantage was taken of the writer being on leave in Washington, D. C., to arrange with H. L. Alden to make simultaneous observations of meteors on the two dates 1923 Nov. 14 and 1923 Dec. 11, these dates being near the maxima of the Leonid and Geminid meteors respectively. Alden observed at the McCormick Observatory, University of Va., (S1); the writer, by the kind permission of the Superintendent, Captain E. T. Pollock, at the Naval Observatory, Washington, D. C., (S2). On both dates observations extended from 13 to 16 hours E. S. T., consecutively, Alden observing to the N. E., Olivier to the S. W. In this way meteors which appeared between the two stations would most readily be seen. On Nov. 14 weather conditions were only fair at both stations, but on Dec. 11, were very good. Nevertheless a striking difference in the totals seen at S1 and S2 proves, at once that the haze and light-reflections from a large city, even on clear nights, cut down the number of meteors seen in its vicinity very considerably. On Nov. 14 Alden recorded 30, Olivier 21; on Dec. 11 Alden recorded 59 and saw 35 more, or 94 in all, Olivier recorded 39 which were all that were seen. After a careful study of the records, 4 probable coinci-

dences on the first night and 5 on the second night were found for which the data were sufficient to calculate the real heights.

The method of computation was that by Schaeberle, found in *Contributions from the Lick Observatory*, No. 5. This method is the one used exclusively by the writer, when only two sets of observations are at hand, and a careful study of these 9 cases so worked out has brought up some interesting points which may be of value to others dealing with similar calculations. Both observers attempted to fix as well as possible the beginning and end points of every meteor, putting our attention rather upon these two points than the direction of flight, which latter can usually be determined much more simply as well as accurately. Almost paradoxically this procedure is likely to result in poorer directions, and hence deduced radiants, than usual, though assuring more accurate real heights, especially with the very long base line, 99.8 miles, that was used. Indeed with such a base line, errors in plotting become less harmful and the heights may come out very well, though the radiant may be poor in a given case. We were unfortunate also because, due to the great distance between our stations, we stood little chance of seeing the same meteor unless it actually came between us. This, coupled with the relative positions of the radiants to our base line, caused the apparent paths of some meteors to have too nearly the same inclination to the equator, as seen from S1 and S2 respectively. This means a greater relative uncertainty in the intersection point, i. e., the radiant. The main purpose was however, as said, to determine heights and in many of the 9 cases this was done with gratifying accuracy for this type of work.

In the table the results are tabulated as follows: serial number; time; height at beginning as observed at S1, at S2, and mean; height at end as observed at S1, at S2, and mean; average deviation of beginning point from mean, of end point from mean; difference of height at beginning and end; total length of path; velocity; observed magnitude at S1, at S2; assuming the figures in the previous column are proportional to $\Delta h$, the corresponding values of $\Delta h_1$ and $\Delta h_2$ in angular measure; the solution of check equation for beginning point, for end point; the radiant. The check equation mentioned is

$$\tan D_2 \sin (\alpha_2 - \alpha_1) - \tan \delta_1 \sin (\alpha_2 - A_2) + \tan \delta_2 \sin (\alpha_1 - A_2) = 0$$

Speaking henceforth of the meteors by the serial numbers, which run from 1 to 9, we at once see that No. 1 appears to rise, while all the others appear to fall. Five cases are found in which $\Delta h_1 < 1^m.0$, and 4 cases in which $\Delta h_2 < 1^m.0$. The two greatest deviations for $\Delta h_1$ are for No. 3 and No. 9. On turning to next to last column this inplies that the error of plotting the beginning points of these two meteors was $\pm 2°.14$ and $\pm 2°.77$ respectively, assuming that the observers made errors of equal amounts and in opposite directions. It may be added that neither meteor belonged to the main streams in activity on those nights. Out of 18 deviations given in these columns, 11 are $<1°$,

while the greatest are the two mentioned. It is thought that the accuracy, thus proved to be attainable in some cases, even in naked eye work, is considerably higher than is usually believed to be within reach, and it is hoped that others may be encouraged to compare their results in a similar manner. No. 1 and No. 4 are Leonids; No.5, No. 6 and No. 7? Geminids; the other four are sporadic. The velocities as usual have an uncertainty of from 10 to 50 per cent and are of little quantitative value. Specifically the most troublesome case is No. 1, especially so because such a small value for $\Delta h_1$ and $\Delta h_2$ is given by the check equations. When both paths were plotted upon a celestial globe it was found that the projection of that seen at S2 cut the apparent path seen at S1. The meteor being a Leonid this proved that the path plotted at S2 was probably at fault. Indeed the S1 path was very near the radiant and hence could not have been oriented very far from correctly, without showing up at a glance. Further, as the projected paths only made an angle of 3°.3 with one another we might expect a specially troublesome case. That the numerical checks came out so well proves the necessity of the computer never discarding the celestial globe, if he wishes to be certain that his calculated results are true. Considering all circumstances it is concluded that, although the errors could not have been large, yet they so combined that the heights for No. 1 are erroneous, and the meteor did not really rise.

| Serial No. | E. S. T. | | | $h_1$ S1 | $h_1$ S2 | $h_1$ Mean | $h_2$ S1 | $h_2$ S2 | $h_2$ Mean | $\Delta h_1$ | $\Delta h_2$ | $h_1 - h_2$ | Length Path | Velocity in Miles : sec. | S1 Magn. | S2 Magn. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | h | m | s | m | m | m | m | m | m | m | m | m | m | | | |
| 1 | 13 | 3 | 1 | 68.6 | 69.6 | 69.1 | 88.1 | 86.6 | 87.3 | 0.8 | 0.5 | —18.2 | 38.3 | 76.6 | 1 | 2 |
| 2 | 14 | 0 | 7 | 88.3 | 82.9 | 85.6 | 48.5 | 51.3 | 49.9 | 2.7 | 1.4 | +35.7 | 36.5 | 36.5 | 2 | 2 |
| 3 | 14 | 20 | 12 | 62.6 | 72.4 | 67.5 | 27.6 | 24.0 | 25.8 | 4.9 | 1.8 | +41.7 | 29.9 | 35.2 | 1 | —1 |
| 4 | 15 | 9 | 57 | 72.8 | 72.0 | 72.4 | 54.8 | 53.7 | 54.3 | 0.4 | 0.5 | +18.1 | 19.3 | 64.4 | 2 | 2 |
| 5 | 13 | 5 | 50 | 57.9 | 58.9 | 58.4 | 44.4 | 47.0 | 45.7 | 0.5 | 1.3 | +12.7 | 13.4 | 26.8 | 2 | 3 |
| 6 | 13 | 41 | 16 | 62.8 | 63.1 | 63.0 | 55.6 | 56.2 | 55.9 | 0.2 | 0.3 | + 7.0 | 7.1 | 14.2 | 5 | 4 |
| 7 | 14 | 24 | 36 | 61.2 | 62.7 | 61.9 | 42.2 | 49.4 | 45.8 | 0.8 | 3.6 | +16.1 | 16.2 | 40.5 | 4 | 4 |
| 8 | 14 | 42 | 3 | 76.0 | 68.6 | 72.3 | 56.1 | 55.6 | 55.9 | 3.7 | 0.2 | +16.4 | 16.9 | 56.3 | 4 | 4 |
| 9 | 15 | 33 | 12 | 54.2 | 43.8 | 49.0 | 32.2 | 38.4 | 35.3 | 5.2 | 3.1 | +13.7 | 17.0 | .... | 3 | 4 |

| No. | Length Path S1 | Length Path S2 | $\Delta h_1$ | $\Delta h_2$ | Check Beginning Point + | Beginning Point — | Beginning Point Δ | Check End Point + | End Point — | End Point Δ | Radiant α | | Radiant δ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ° | ° | ° | ° | | | | | | | ° | ′ | ° | ′ |
| 1 | 16.3 | 13.5 | 0.65 | 0.40 | 387 | —399 | — 12 | 381 | 363 | +18 | 131 | 38 | +21 | 29 |
| 2 | 14.3 | 12.3 | 1.01 | 0.52 | 638 | 581 | + 57 | 492 | 513 | —21 | 37 | 25 | +18 | 29 |
| 3 | 21.2 | 15.0 | 2.14 | 1.43 | 944 | 1128 | —184 | 830 | 737 | +93 | 55 | 6 | + 5 | 9 |
| 4 | 5.3 | 11.7 | 0.19 | 0.28 | 597 | 585 | + 8 | 622 | 602 | +20 | 147 | 29 | +20 | 38 |
| 5 | 3.8 | 8.3 | 0.24 | 0.62 | 576 | 602 | — 26 | 496 | 544 | —48 | 76 | 21 | +16 | 56 |
| 6 | 3.3 | 2.7 | 0.09 | 0.13 | 849 | 853 | — 4 | 809 | 810 | — 1 | 110 | 12 | +30 | 35 |
| 7 | 10.0 | 5.0 | 0.38 | 1.68 | 697 | 723 | — 26 | 525 | 649 | —124 | 164 | 50 | +49 | 24 |
| 8 | 5.6 | 6.7 | 1.39 | 0.08 | 1028 | 897 | +131 | 791 | 772 | +19 | ... | .. | .... | .. |
| 9 | 7.3 | 7.3 | 2.77 | 1.64 | 632 | 515 | +117 | 554 | 490 | +64 | 234 | 9 | +16 | 51 |

A somewhat similar case is found in No. 8. Here we obtain a fair check for the beginning point, a splendid check for the end point. But the meteor was an undoubted Geminid, and its path was relatively near the radiant as seen at S2. The projection of the path at S1 does not cut the projection of the path seen at S2. Nevertheless a relatively small change in the inclination observed at S1 would make this conform to the Geminid radiant, and we have sound reasons for deciding that the same meteor was observed at both stations, even if a radiant cannot be calculated from the plotted paths. The excellent check for the end point indicates that the error probably lies in the beginning point as plotted at S1. As to No. 7, according to observations at S2 it could well have been a somewhat discordant Geminid, but the projected path at S1 comes nowhere near the Geminid radiant. Again the path at S1 is longer than that at S2, yet the former begins very near the radiant. Two hypotheses are about equally probable: (a) this case has really to do with two separate meteors, (b) the end point at one station or the other is somewhat erroneous. The other six cases call for no special comment.

Considerable space has been devoted to these few cases because the statement has been made by certain meteor observers that duplicate observations of the same object furnish radiants whose existence cannot be questioned and hence furnish excellent data for the discussion of so-called stationary radiants. This discussion proves that unless the two apparent tracks are favorably placed relative to one another, i. e., make a large angle, the derived radiant is far poorer than those deduced from several tracks of meteors, belonging to the same stream, seen from the same station. To prove this point further a study of the maps used on these two nights shows that for the Leonid radiant as seen at S1 a good distribution of meteors in various directions was had and hence a good radiant deduced. But at S2 all the 6 Leonids plotted fell within a sector of only 30°, and hence the radiant was uncertain in right ascension, though fairly enough determinable in declination. With the Geminid radiant the reverse was the case. Here a good distribution in angle between the paths of the meteors was had at S2 and therefore a good radiant resulted. But the radiant was so situated as seen from S1 that a small distribution in angle was had and hence the radiant's position could be only fairly determined. These radiants, however, prove that the abnormally poor radiants from duplicate observations for No. 1, No. 5 and No. 7? are wholly due to the small difference in inclination to the equator of their paths as seen from S1 and S2, and not to abnormally large errors of plotting.

As to determining the possible coincidences in general, to have had a recorder write the exact second of appearance, or to have used chronographs, would have been a great help to the observers, and would have at once removed the probability of a wrong identification as mentioned above for No. 7. It may be added that a base line of

not less than 40 nor more than 60 miles would seem most advantageous, while the azimuth of this line is a most important consideration when any special shower is under observation. It is hoped that other American observers will take up this kind of work, as in volume we are at present hopelessly behind our English colleagues and rapidly falling behind several other European countries.

The writer is greatly indebted to his colleague, Dr. H. L. Alden, without whose cordial coöperation this work could not have been carried out. He also desires to express his great obligations to the Superintendent of the U. S. Naval Observatory, Captain E. T. Pollock, for the use of its library not only in preparing this paper, but also for carrying out a much more extended piece of work on meteors, the preparation of which took six months and which it is hoped will shortly appear elsewhere.

Leander McCormick Observatory,
University, Va., 1924 June 7.

## THE "SEAS" OF MARS.

By G. H. HAMILTON.

One of the finest examples, one can hardly call it a relic, of the school of analogy, can be found on any modern map of the moon. It may be left to the globe encircling aeronauts, as to the color of the earthly seas when compared with the land, but at the time the first details on the moon were charted and named, the seas were supposed to be the darker, and—by analogy—all the dark areas on the moon were called seas, and believed to be such.

The school of analogy has its roots deep seated in the minds of many. At the time that the planet Mars was first able to be observed for detail upon its surface, through improved optical means, the seas on the moon had lost their significance—but not their names. Human thought is very hard to change, evidenced by the similarity in human nature throughout historic times and *proved* so in the case of Mars. Though reasoning by analogy was wrong in the case of the moon, the lesson was not learned, the dark areas on Mars when first seen were at once called seas—by earthly analogy again; not only called seas but believed to be so, by some even now, and by most as late as 1892, when Professor Pickering discovered detail covering the dark areas, and in so permanent a manner that the seas had again to be discarded as they were upon the moon.

Analogy is, of necessity, fostered—we all have to learn from others; and unless we are in a position to gather facts ourselves after our first tutelage, we will invariably follow, Indian fashion, in the footsteps of those who have gone before.

Though the areas on the moon, called seas, have no real evidence of

ever having been such, the dark areas on Mars are now termed sea beds, or sea bottoms—thus will an idea, once rooted, flourish under another guise. Changes have been seen to occur in these areas, not only in tone and color, but in their contour as well. An explanation has been given for these changes which has not yet been disproved and will be hard to disprove—vegetation. Vegetation will, and may, account for most of these, especially the tone and color; but the changes in contour, though possibly accounted for by vegetation, can not be accounted for if a permanent rivage of an ancient sea is still accepted.

I have been one who has always talked and written about "sea beds" when speaking of Mars, and even acquiesced in their being at a slightly lower level than the surrounding "deserts." I have bowed to accepted dictum for I had no other course or evidence at hand; but the actual shift in contour and shape of these areas has worried me. Seeing them only during the last four oppositions, when they were badly placed on the visible disk, gave me no opportunity to study them with exactness. Now, my fifth opposition, they are well placed and cover over half of the face of Mars—and what a vista opens to my view!

I If Mars had oceans,
  1 Why only at one pole?
  2 Why in the form of inland seas?
  3 Why not vast areas as on earth with convex boundaries?

II If there are ancient sea beds,
  1 Why the network crossing them similarly to that in the deserts?
  2 Why should this whole network over desert and sea bottom change with the seasons as do the sea beds themselves?
  3 Why should the coast-lines vary in position and shape?

III If the network of detail over the whole surface is similar to that in the dark areas in the southern hemisphere, why the apparent difference between the northern and southern hemispheres?

Some of these questions have, up to now, been, in a way, answered. Taking them as a whole and noting those outstanding, are the answers already given sufficient?

Answer as given for I, 3: Mars is a small planet. It never had sufficient mass to hold a large sea-forming atmosphere.

Answer as given for II, 1: The sea beds are natural vegetation, the "canals" cultivated areas or strips across them. Second answer: There are no "canals" crossing the sea bottoms, they are an optical illusion.

Answer as given for II, 2: The "canals" are vegetation, the sea beds are covered with vegetation—therefore they all change with the seasons. Second answer: Canals not admitted, they do not change with the seasons.

Answer as given for II, 3: There is a vegetational "creep" away

# PLATE XXIX.

Mars 1924.

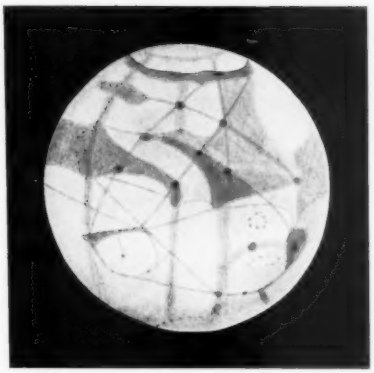

Fig. 1. August 9. Seeing 9-10. $\lambda = 239°.9$.

Mars 1924.

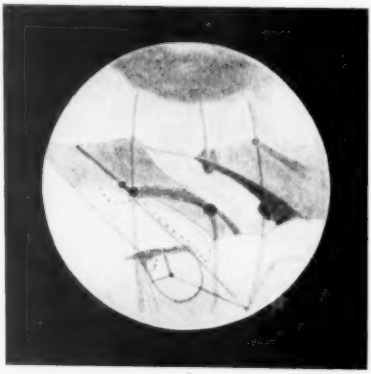

Fig. 2. September 12. Seeing 7-8. $\lambda = 228°.6$.

Mars 1909. Lowell's Globe.

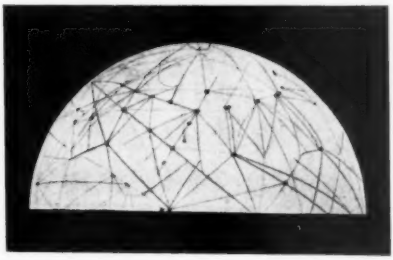

Fig. 3. Southern Hemisphere. $\lambda = 180°$
Pencil sketch. Dark Maria removed.

Mars 1903. Lowell's Globe.

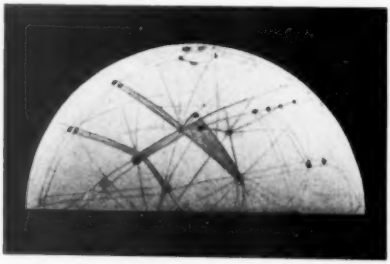

Fig. 4. Northern Hemisphere. $\lambda = 270°$
Pencil sketch at present time.

Mars 1924.

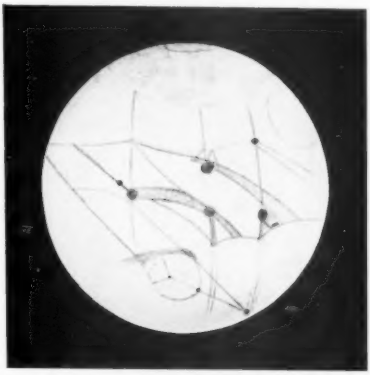

Fig. 5. September 12. Seeing 7-8. $\lambda = 228°.6$.
Dark Maria removed in part.

from the coast-lines, both outward and inward with the seasons. Or, there is a "flooding" or "drying up" of waters from the polar snows.

Of seven questions four have been answered, and three not—unless I, 2 has been partly answered by that for I, 3.

Of the four answered, one stands out at once as not admissible from facts observed—at least in the way it stands. If the answer to II, 3 were correct, the coast-lines, as seen, would be very irregular from the nature of the "creep." At this opposition, 1924, they have been seen to be *not* irregular.

If the "canals" are optical illusions, the dead sea bottom theory is completely broken down, for the "canals" crossing these sea bottoms have been the cause of real seas being thought absent on Mars. Fortunately or unfortunately the real seas cannot be brought back again, for the boundaries of the dark areas neither act nor look like coast lines. The optical possibilities in viewing Mars have been elsewhere discussed. I do not intend to continue the controversy here, but will simply state that I believe in the linearity and fineness of the "canals," in their objective reality, and hold that I cannot have been deceived.

As to the drawings made at this opposition, the dark areas show one outstanding feature—they are regular in shape. Where they change in tone near the center of the disk—the only portion of the planet worthy of accurate study for this phenomenon—the various tonal areas are also regular. Canal-like markings, it is true, cross these areas of different tone, but the *edges* of these areas can be sometimes seen as canals, and if not, owing to the density of the areas themselves, they have yet the appearance of being *bounded* by canals though the canals themselves may be invisible. Starting from observations of this kind, I decided to see if the "invisible canals" bounding these dark areas became apparent as they left them. In other words, whether the canals extended outward from these bounding edges and continued as "visible canals" into the lighter regions. I found this to be so.

Having data such as these to go on, and realizing that the dark areas had increased and decreased during the period of observation—I have already had (September 28) over 90 days in which to make good observations—I decided to take great care in observing the canal formations near the boundaries of the dark areas, both in the areas themselves and the adjoining deserts. I have had some interesting results for the pains taken. Whole areas have darkened up within regions bounded by previously observed canals; others have faded out leaving observable canals in the place of what were, earlier, boundaries of the dark areas or different tonal regions!

I have noticed no "creep" of the dark areas, except perhaps around the polar cap. Where the dark areas have extended into the desert they have gradually appeared to darken over their whole surface, or when intermediate observations have been lacking, they have suddenly appeared within the confining limits of already existing canals. This

cannot be taken for an "overflow" of existing boundaries, but a definite preparation over areas at a time and a simultaneous change in appearance over these areas.

The canals that form these boundaries are not necessarily *great circles*. In some cases I believe they are, in others they do not seem to be. The most obvious cases for *small circles* would be the northern boundaries of the southern dark areas between points such as Sinus Titanum, Aethiops, Syrtis Minor and the stretch from Sinus Titanum to the Beak of the Sirens. I have drawn great circles on a sphere with their southern edges at equal or nearly equal distances from the south pole, and the contours formed by them at their intersections give a fair representation of the actual coastline. If the coast-lines are actually bounded by great circle canals the curves may be composed of more than a single canal; this is extremely probable, since many canals are seen to come tangentially out of these points of intersection, not only into the desert but inwards into the dark areas themselves. We then have a system of curves geometrically formed of many tangents, similar to the old proposition of finding the circumference of a circle by drawing tangents to it and forming polygons increasing in number of sides.

It is difficult to reconcile the shape of the Syrtis Major with an area bounded by numerous canals. It is notable, however, that under whatever form it may appear at different oppositions or even at different times in the same opposition, the *skeleton* is the same, and the short areas of coast-line bounding it are very definite in form and have a *raison d'être*.

Now Dr. Lowell often stated that detail on the planet had various orders of visibility. In a sense, M. Antoniadi realizes the same thing when he speaks of the *time* that a thing may remain visible under the scrutiny of the eye. But the "seeing" enters into M. Antoniadi's "time" whereas size alone is here meant in Dr. Lowell's "orders." It was my great pleasure while visiting Dr. Lowell in 1916 to see his newly discovered *third* order of small detail on the surface of Mars. This detail was a little formation of the same shape as Elysium, east of the Proponti and at about its same latitude. I do not remember what Dr. Lowell named it, but the oasis or "Fons" in its center he called Fons Senectute to match the Fons Immortalis in Elysium proper. The spoke-like canals radiating from the Fons Senectute were certainly of a finer order than those in Elysium and which he considered of the second order. Now the Fons Immortalis and its attendant canals have been easily visible here at this opposition, and Professor Pickering and I have both suspected the small "Elysium," though seen as a whole.

This appearance of fine canals seen in 1916, led Dr. Lowell to remark that in all probability there was no limit to these orders of fineness, and that their discovery only awaited better opportunity or better optical means. He also thought the large canals might themselves be connect-

ed by canals of finer quality—just as the canals forming Elysium and Isidis are connected.

The appearance of the Syrtis, in all its shapes and forms, could be explained by the presence of these small canals. Let it be granted then that *all* the dark areas on Mars are dependent for their shapes on the canal pattern. Returning to question III, why the apparent difference between the northern and southern hemispheres?

*Is* there a difference?

Has anyone made a skeleton sketch of the canals in the southern region and its oases *without filling in the dark areas?* Or conversely, has anyone filled in a probable set of dark areas between the innumerable canals in the northern region?

Besides two of my own drawings made at this opposition, I am publishing one of Dr. Lowell's globes of 1909 just as I find it but with the dark areas of the southern region removed—leaving only the canals and oases. Along with this, I will reproduce a copy of his globe of 1903, showing the northern region as he depicted it but turned so that the north pole will be in the same position as the south of the 1909 globe. My drawing of September 12, 1924, will also be published both with and without the dark areas in the southern region. I believe that the figures will explain themselves, or at least open up new channels for thought (Plate XXIX).*

What may be the reason for this "difference without a difference"? The canals are seemingly just as numerous in both hemispheres and just as fortuitously placed. Let us see if there may be any known facts about the planet which may account for "vegetational areas" in one hemisphere and an almost complete lack in the other.

The seasonal differences between the two hemispheres follow:

| | Northern Hemisphere | Southern Hemisphere |
|---|---|---|
| Spring | 181 days | 147 days† |
| Summer | 191 " | 149 " |
| Autumn | 149 " | 191 " |
| Winter | 147 " | 181 " |

These differences are due to the fact that Mars is approaching perihelion for its southern mid-summer. It is now nearer the sun during summer in the southern hemisphere, and farther from it in winter.

The combined action of this position of the planet in its orbit and the tilt of its polar axis produces a very large southern cap during the long and cold winter, and a very small one, sometimes entirely lacking, during its comparatively short but very warm summer. In the case of the northern hemisphere, there is a medium sized cap during its short

*In the globe for 1909 with the dark areas removed, I have not drawn in the boundaries to the dark areas except where there was a definite canal showing. In the case of the skeleton of the drawing of September 12, the boundaries to the dark areas have been left in, for they did appear definite and canal-like in form. In this drawing, also, the most intense dark areas have been left in, since they bear a striking resemblance to the existing dark areas shown on the globe of 1903.

†Lowell, "Mars"

winter which its long and cool summer cannot completely melt.

The effect of this on the two hemispheres is apparent from their appearance. The large southern cap completely melts and unlocks a large quantity of moisture for use during the summer in that hemisphere, while the moisture from the smaller and never completely melted northern cap is used for the small dark areas in its hemisphere, and also for the existing dark areas around the equator and probably beyond and into the southern hemisphere. In short, the southern hemisphere has more water at its disposal and therefore greater areas may be cultivated.

What then will occur when a time has elapsed equivalent to one-half of Mars' precessional cycle? The hemispheres will have changed places as far as climatic conditions are concerned, and the preponderance of moisture will be stored up and unlocked in the northern rather than the southern hemisphere. Looking at the drawings, I think it is possible to see that the northern hemisphere of the present day is adequately prepared to take advantage of this time when it arrives.

Why then is the northern hemisphere prepared in this manner so far in advance? We are told that life on Earth and conditions to support it have existed for millions of years, yet our civilization is hardly a second of time in the geologic day. What then can a few more seconds do to change the existing order of things on Earth?

The precessional cycle of Mars is a little over 7 times as long as that of the earth (vide Struve), a matter of 180,000 odd years in comparison to our, roughly, 25,000 years. Now historic times have spanned a quarter of our own precessional cycle; it would only require four more seconds of geologic time to complete the cycle and be back again to the present order of things. Mars is undoubtedly far older than the earth and its civilization can be estimated in hours rather than in seconds. Its northern hemisphere is not, therefore, prepared in *advance* for a time to come, rather has it already had that time and still awaits another.

Mandeville, Jamaica, September, 1924.

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## MARS.

In the east against the darkening
Twilight of the summer day,
Mars, a coal of fire is rising,
Rising slowly in the sky.

Fierce it glows beyond the pine trees,
With a redness all its own,
Rising lonely, while the night breeze
Stirs the branches with a moan.

On it many eyes are fastened,
Man is searching for the key,
Key to truth in wider boundaries,
Mars, the star of mystery.

CATHERINE CATE COBLENTZ.
Mars Hill, Lowell Observatory, Flagstaff, Arizona.

# MEASUREMENTS OF THE RADIATION FROM THE PLANET MARS.

By EDISON PETTIT and SETH B. NICHOLSON.

The radiation from Mars has been measured with vacuum thermocouples attached to the 100-inch telescope, at intervals over a period of about a year. The measurements cover a considerable variety of observing conditions as well as phases, distances and seasons on the planet.

The term "radiation" is used to cover both the radiant energy given off by the warmed surface of the planet and the sunlight reflected from it. There is a common belief that the thermocouple measures "heat radiation," but the fact is that it measures impartally radiation of all wavelengths which falls upon its blackened junctions. It will measure ultra-violet and visual light quite as readily as the infra-red or "heat radiation." In the case of an early-type star most of the radiation which the thermocouple measures is visual light, while in the case of the moon or Mars most of the radiation is invisible and is confined to the far infra-red.

In the measurement of stellar radiation there is probably little difference between the reflector and the refractor, aperture being the principal consideration. In the case of the red stars there would be some troublesome corrections if a refractor were used. For observing the radiation from planets it is necessary to use a reflector, since a piece of glass as thin as a microscope cover-glass is opaque to most of the radiation from their heated surfaces. About all the radiation which a refractor transmits is the reflected sun-light, which in the case of Mars is about 44 percent of the radiation falling on the objective and 14 percent in the case of the moon. The radiation from the dark side of Venus produces a large deflection, but is entirely cut off by a microscope cover-glass.

The principal observing equipment consists of the telescope which collects the radiation, a vacuum thermocouple which changes the radiation to electrical energy, a galvanometer to measure the current, a photographic device which registers the galvanometer deflections, and a comparator for measuring the plates upon which the deflections of the galvanometer have been traced photographically.

Plate XXX shows the Newtonian cage of the 100-inch telescope with the thermocouple equipment attached. The thermocouple is clamped to the square plate P in front of the eyepiece E in the double slide plate-holder which is used for direct photography. By means of the lever L a water cell, glass plate or fluorite plate can be thrown in front of the thermocouple in order to study the spectral distribution of the radiation being measured. The cable C carries the current from

the thermocouple to the D'Arsonval galvanometer which, together with the registering device is in the basement of the dome, 135 feet away. The telephone T connects the observer at the thermocouple with the observer at the galvanometer.

Plate XXX A shows one of the vacuum thermocouple cells which we have used in measuring the radiation from Mars. The radiation is admitted to the cell by a rock-salt window W. A glass window C enables the observer to see both planet and thermocouple simultaneously, much as one sees cross wires in a finder. The vacuum in the cell, which must be better than that in an X-ray tube in order to keep the thermocouple at its highest efficiency, eliminates losses of heat due to conduction and convection through the air, and increases the deflections about eleven fold.[1]

Looking into the eyepiece E (Plate XXX), one sees the thermocouple junctions as shown in Plate XXX B. By turning the guiding handle H (Plate XXX) either of the small octagonal receivers can be placed on the image of the planet. When these junctions are heated alternately by the image of the planet, they produce currents in reverse

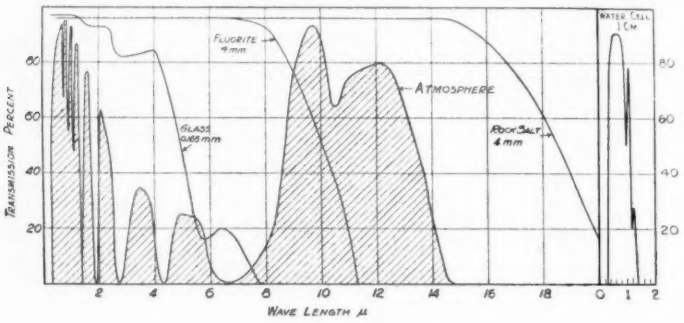



Fig. 1.

Transmission curves of the atmosphere (the shaded curve), glass plate (microscope cover-glass), fluorite plate, rock-salt window and water cell.

directions, and therefore any general radiation, such as that from the sky or the telescope, which falls on both at once, produces a null effect. Hence the instrument can be used to observe stars and planets in the daytime and gives the same deflections as at night. The effect of bad seeing is to decrease the deflections and produce irregular curves.

Two thermocouples were employed in observing the radiation from Mars; No. 36 having receivers 0.8 mm in diameter, used to measure the integrated radiation from the planet, and No. 42 having receivers 0.40 by 0.20 mm, used for observations of planetary markings, drift curves, etc.

[1] *Astrophysical Journal*, Vol. 56, pp. 295-317, 1922.

The three screens, a water cell 1 cm thick, a glass plate 0.165 mm thick and a fluorite plate 4 mm thick, made it possible to isolate the regions $0.3\mu$ to $1.3\mu$, $1.3\mu$ to $5.5\mu$, $8\mu$ to $11\mu$ and $11\mu$ to $14\mu$, when combined with the transmission of the atmosphere. Transmission curves for the atmosphere (the shaded curve), for the rock-salt window of the thermocouple cell and for the three transmission screens, are shown in Figure 1. The absorption of the atmosphere is due principally to the water-vapor, carbon dioxide, oxygen and ozone. It is through the great transmission band $8\mu$ - $14\mu$ that we receive most of the radiation from the heated surfaces of the planets, although a small amount comes through the weak bands between $3\mu$ and $5.5\mu$. This we shall call *planetary radiation*. A comparison of these curves will show the need of reflecting telescopes and rock-salt windows in the measurement of planetary radiation.

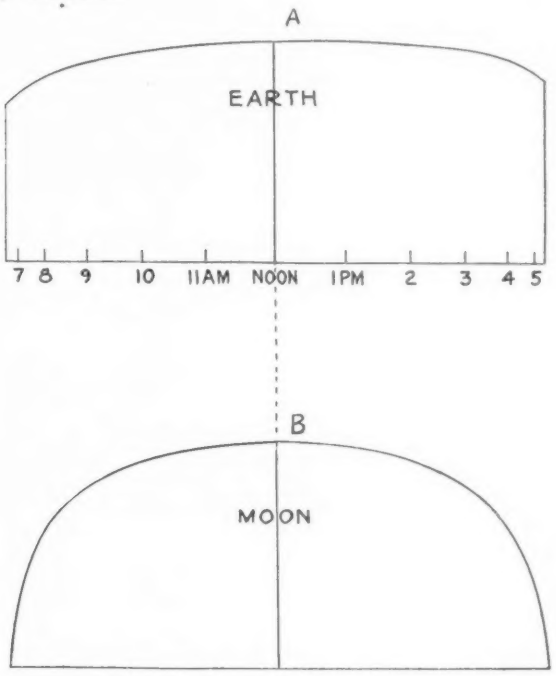



FIG. 2.

Curves of planetary radiation across the earth (computed for the 39th parallel) and across the moon (observed).

The registering device consists of an apparatus by means of which a photographic plate is moved vertically by a motor-driven screw. Light from a straight filament lamp is reflected from the galvanometer

mirror and forms an image of the filament upon a long cylindrical lens placed horizontally in front of the plate. The part of the image intercepted by the lens forms a point of light upon the plate, where it traces a line. A synchronized contact gives a signal on a buzzer at the telescope for each centimeter which the plate moves. At each of these signals the observer at the telescopes shifts the thermocouple so that the image of the planet or star falls on the other receiver. The resulting deflection of the galvanometer produces a line which is displaced alternately right and left upon the plate and the amount of this displacement measures the amount of the radiation received by the thermocouple.

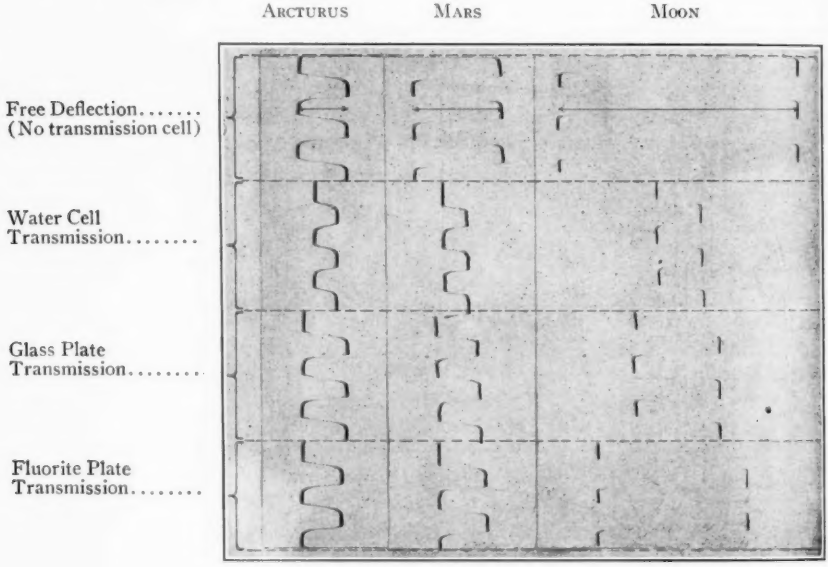
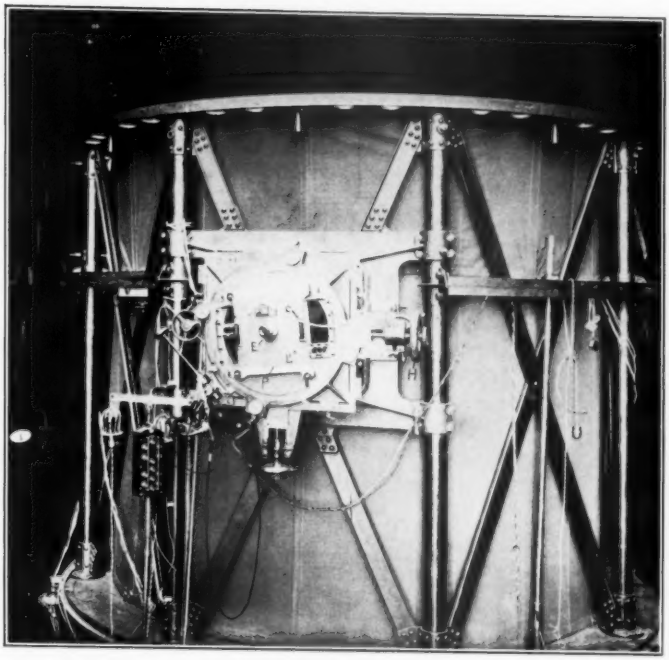



Fig. 3.

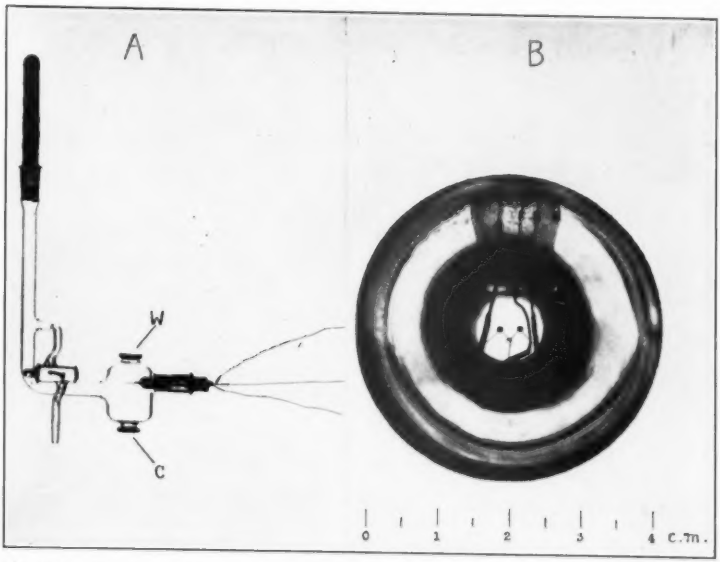
Galvanometer deflections from the radiation from Arcturus, Mars and the moon. The size of the deflections is indicated by the arrows.

Figure 3 shows a set of such deflections for Arcturus, Mars and the moon. The values of the free deflections are indicated by the arrows. It will be noted that in the cases of Mars and the moon only a relatively small fraction of the radiation passes through the water cell and cover-glass, while in the case of Arcturus about half of it comes through the water cell and about ninety percent through the cover-glass. This indicates the presence of less infra-red radiation from Arcturus than from Mars and the moon.

The radiometric magnitude of Mars (the magnitude of an A0 star



Upper end of the tube of the 100-inch telescope showing the Newtonian plate-holder with thermocouple attached.




(A) The vacuum thermocouple as used in the observations of radiation from Mars.
(B) Junctions of the thermocouple as seen by the observer looking into the eye-piece E.

from which we would receive the same amount of radiation) was determined by measuring the radiation from stars in the same region of the sky. The radiometric magnitudes of these stars has been determined by a considerable number of direct comparisons and the atmospheric absorption factors to reduce the observations to the zenith have been determined for both the stars and the planet. Since the image of the planet at opposition is twice the diameter of the receivers of couple No. 36, it is necessary to make a correction for the amount which does not fall upon the receivers. This correction factor was obtained by integrating the drift curves made with couple No. 42 and its value is 0.78 magnitude. If we apply this correction to the radiometric magnitude determined when the junction is placed centrally upon the planet, we find that the radiometric magnitude of Mars at this opposition was —3.92, which is its maximum brightness. The radiometric magnitude of the *dark hemisphere* of Venus at inferior conjunction is nearly one magnitude brighter, namely —4.84. The radiometric magnitude of Sirius is only —1.3, more than two and one-half magnitudes fainter.

In Table I will be found the distribution of the energy in the spectrum of various features on Mars determined with the transmission cells compared with similar data for the moon, Mercury, the sun and Arcturus.

TABLE I.

| | Reflected Light | | Planetary Radiation | | | |
|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI |
| | 0.3μ-1.3μ | 1.3μ-5.5μ | 1.3μ-5.5μ | 8μ-11μ | 11μ-14μ | 8μ-14μ |
| Mars (Center disk | 28.2 | 13.6 | 6.8 | 17.2 | 34.3 | 51.5 |
| (Pole cap | 33.6 | 16.2 | 13.3 | 6.7 | 30.0 | 37.0 |
| (Integrated | 29.9 | 14.4 | 4.5 | 13.9 | 37.1 | 51.0 |
| Moon (Center, full phase) | 9.5 | 4.6 | 6.2 | 31.2 | 48.5 | 79.7 |
| Mercury | 6.5 | 3.2 | 20.2 | 37.6 | 32.5 | 70.0 |
| Sun | 67.5 | 32.5 | 0 | 0 | 0 | 0 |
| Arcturus | 49.2 | 48.0 | .... | .... | .... | (2.8) |

An inspection of the table will show that Mars is much like Mercury and the moon in that a large percentage of the radiation which it emits is transmitted by our atmosphere through the band between 8μ and 14μ (planetary radiation). Only about 8 percent of the radiation received from Jupiter, Saturn and Venus at full phase is planetary radiation.

The values given in columns II and III are computed from the values in columns I and VI assuming that the sunlight is unaltered in quality upon reflection. This indeed is not true, as the color of Mars testifies, and therefore these transmissions have not been used in computing the temperatures for this planet. The values in columns IV, V and VI can be used with more confidence, but here we are confronted with only a general knowledge of the atmospheric transmission in this region of the spectrum.

The amount of the correction to be applied to observed radiation to

reduce it to the value it would have outside our atmosphere depends largely on the temperature of the body, the altitude of the observing station and the water vapor content of the atmosphere. The atmosphere transmits three-fourths of the radiation from the sun at the zenith on Mount Wilson, but only one-fourth of the planetary radiation from Mars. Obviously, in the region of low temperatures, the atmospheric corrections will reach a minimum value for the temperature for which the black body curve has a maximum near the middle of the $8\mu - 14\mu$ transmission band. A simple computation shows this to be about 265° absolute (—8° C). On either side of this minimum the curve of atmospheric correction against temperature rises steeply, more so on the violet than on the red side. As a result of this asymmetry the minimum actually falls at 290° absolute, where the value of the ratio of the total radiation emitted to that transmitted by the atmosphere on Mount Wilson under average conditions is about 1.4, but reaches 9.3 at 200° C absolute.

We may estimate the temperature of a point on Mars by two methods. First, we may attempt to make the data in Table I fit a black body radiation curve after applying the atmospheric transmission to it, or we may employ the principle of the total radiation formula (fourth power law). In either case the uncertainty of the atmospheric corrections affects the results. The temperatures of Mars computed by the two methods are indicated in Table II.

TABLE II.

| | Temperature Absolute | | |
|---|---|---|---|
| | From Spectrum | From 4th Power Law | Average |
| Center, full phase | 285° C | 275° C | 280° C |
| Limb | | 260 | 260 |
| Pole-Cap | 170 | 240 | 205 |
| Integrated Disk | 240 | 260 | 250 |

The radiation from the disk as a whole comes from regions of considerably different temperatures. In computing the temperature from the integrated radiation of the disk we have used the atmospheric corrections for the temperature for which a black body curve best fits the observations, and the temperature so computed can be regarded only as a general check upon the results. The uncertainty in our knowledge of the water vapor content of the atmosphere affects the values derived from the spectrum and from the fourth power law in opposite directions, and the effect is more pronounced for the low temperatures. Probably the best we can do at present it to take the average.

From these results we may conclude that the radiation temperature of a point in the tropics at noon-day on Mars is a little above freezing and that the mean temperature of the pole cap is about —70° C. The measures on the limb give the mean value over a region extending inward to about one-fourth of the radius toward the center in the tropics, and is about —13° C. The actual temperature at the limb is much lower than this.

That a deflection toward the side of heat is obtained from a body colder than the thermocouple receiver may at first seem somewhat surprising, but a little consideration will show that such is the case. Both receivers are radiating continually through the bands in the atmosphere to space where the temperature is absolute zero. When one junction is covered and the thermocouple then exposed to the sky

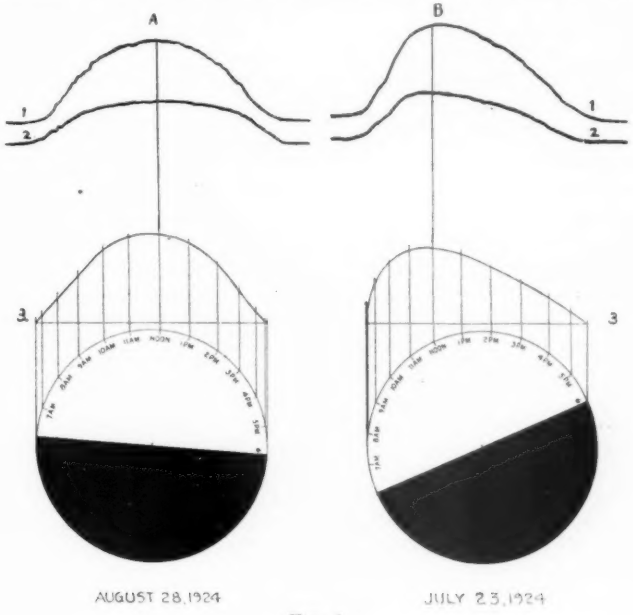



FIG. 4.

(1) Radiation curve across Mars near the equator (free deflection). (2) The same with glass plate inserted in the beam. (3) Curve of planetary radiation across Mars along the equator computed from Nos. (1) and (2) above, and its relation to the planet at the time of observation, A, five days after opposition and B, one month before opposition.

an enormous deflection is registered to the side of cold, since one junction is radiating to space while the other exchanges radiation with the shield. Any object in space which has any heat at all will therefore give a positive deflection regardless of the temperature of the thermocouple.

We may gain some knowledge about the planet's atmosphere and the distribution of heat over its surface by means of drift curves. These curves are obtained by driving the thermocouple junction slowly across the image of the planet and driving the registering device at the same time, both with uniform motion. They are taken in both an east and

west direction and in a north and south direction, without and with transmission cells.

Figure 4 illustrates drift curves taken in this manner, A when the planet was five days past opposition, and B one month before the time of opposition. The two upper curves (Nos. 1 and 2) are the original curves taken "free," i. e., without any cell interposed in the beam, and with the glass plate interposed in the beam. Since the glass plate transmits all radiation up to 5.5$\mu$ the differences in the ordinates of these two curves measure the planetary radiation emitted. Curves No. 3 (below) are these differences (corrected for small differential factors due to the orientation of the planet's axis relative to the line of drift across its disk during the observation and the integrating effect of the receiver) plotted to the same scale. They represent the march of the planetary heat as the thermocouple junction moves along a parallel of latitude where the sun is in the zenith at noon. Below each of these sets of curves A and B are diagrams representing equatorial cross-sections of Mars with hours of the day marked upon them in the same relation to the curve that they had during the observation. Lines drawn from these hour marks upward indicate the corresponding points on the radiation curves. No appreciable displacement of the maximum of radiation from the noon point on Mars will be noted either in the original curves or the plotted curves of planetary heat, either at opposition or one month before that time. This result does not agree with that reported by Coblentz and Lampland, who found the temperature higher in the Martian afternoon than in the forenoon.[1]

We may inquire what form of curve we might get from a planet like the earth having a considerable atmosphere, or again from a planet like Mercury or the moon which has a negligible atmosphere. Figure 2 A shows a plot of the theoretical distribution of planetary heat across the earth along the 39th parallel of latitude as seen by an observer on a similar planet. This curve is computed from temperature curves taken at Mount Weather, Va.,[2] and the Eclipse Station at Matheson, Colorado,[3] near mid-summer. It is very suggestive of the distribution of planetary heat across Venus.

Figure 2 B shows the curve of planetary radiation across the full moon. It strongly resembles in form the curve of planetary radiation across Mars (Figure 4, A3). These results, which are confirmed by the large percentage of radiation between 8$\mu$ and 14$\mu$ and its spectral distribution, indicate the practical absence of water vapor and the improbability of an atmosphere of density at all comparable to that of the earth. A detailed discussion of these observations and conclusions will appear in the *Astrophysical Journal*.

Mount Wilson Observatory, October 18, 1924.

[1] *Science* **60**, 295, 1924. *Pub. Astronomical Society of the Pacific* **36**, 272, 1924. *Popular Astronomy* **32**, 571, 1924.

[2] Bull. Mount Weather Observatory **4**, 389, 1912.

[3] Popular Astronomy **26**, 466, 1918.

## THE AMERICAN SECTION OF THE INTERNATIONAL ASTRONOMICAL UNION.

By JOEL STEBBINS.

The International Astronomical Union will hold its third meeting in Cambridge, England, beginning July 7, 1925. No doubt there will be a considerable group of American astronomers who will go abroad for this meeting, especially some of those who were fortunate to be either at the Brussels meeting in 1919 or at Rome in 1922. These triennial meetings serve to bring the astronomers of different countries together for discussion of topics of mutual interest, but at the formal sessions there are no papers by individual authors, the main business being carried on by committees, and much of the general meeting is taken up by the discussion of technical committee reports. There are also matters of policy and other questions brought up by the national committees.

The Union is chartered under the auspices of the International Research Council, and according to the statutes of the Union each adhering country is represented by a national committee formed by each nation for itself. As the method of participation by the United States is not generally understood, it seems well to repeat here the description of the organization of the American national committee of the Union, or, as it is called, the American Section, which is a committee of the National Research Council.

### Organization of The American Section of The International Astronomical Union.

1. The Executive Committee of the American Section shall consist of the three astronomical members of the Division of Physical Sciences of the National Research Council and (ex officio) of the President and the Secretary of the American Astronomical Society. If the President or the Secretary is a member of the Division of Physical Sciences, the Council of the Society shall appoint a member of the Executive Committee in replacement, so that the Committee shall always consist of five members.

2. The duties of the Executive Committee shall be: to act as the representatives of the United States in the International Astronomical Union in the interim between its triennial meetings; to organize the American Section and to arrange for a meeting of the American Section shortly preceding each triennial meeting of the Union; to select delegates to the meetings of the Union; and in general to deal with all international astronomical questions involving the partcipation of the United States. The Chairman of the Executive Committee of the American Section shall (ex-officio) be a member of the Division of Foreign Relations of the National Research Council.

3. Not less than six months before the date of each triennial meeting of the International Astronomical Union the Executive Committee shall invite all American astronomers who are members of the technical committees of the Union, and such other persons as may seem desirable, to submit suggestions for the promotion of the work of the Union. Not less than four months prior to the triennial meeting the Executive Committee shall formulate and make known general plans for a meeting of the American Section of the Union, to be held in Washington not more than two months, and preferably not more than one month, before the date of the triennial meeting of the Union, and, as far as practicable, shall select the astronomical members of the Section. The Executive Committee shall at the same time present to the Division of Physical Sciences of the National Research Council a statement of these plans as a basis for the request that the physicists, mathematicians, and geophysicists who are members of the Division will advise in the selection of delegates to represent their subjects at the coming meetings of the Section and of the Union.

4. The Executive Committee shall select delegates to the meetings of the International Astronomical Union at such times as, in their judgment, seem wise and desirable. Additional delegates to the triennial meetings of the Union may be selected on the initiative of the Section, assembled in Washington, by a majority vote of all members of the Section present.

5. The American Section, excepting its Executive Committee, shall automatically go out of existence at the close of the corresponding triennial meeting of the Union.

The American Section is composed of all astronomers and other scientific men who are members of the American technical committees appointed by the Executive Committee. It will be noted that, although the Executive Committee is a permanent body, it has a changing membership, as there is a new astronomical representative each year on the Division of Physical Sciences. The present personnel of the Executive Committee is Ernest W. Brown, *Chairman;* W. W. Campbell, Edwin B. Frost, Harlow Shapley, and Joel Stebbins, *Secretary*.

In preparation for the meeting at Cambridge, the Executive Committee of the American Section met in August, 1924, at Dartmouth, and appointed committees of American astronomers to discuss, as far as desirable, the same fields as the corresponding international committees. Committees were appointed only in those cases where it was felt that American reports could be made to advantage in advance of the meeting of the Union. Each committee was asked to present

*(a)* A brief résumé of progress made in the United States since the last international meeting.

(*b*) Suggestions, if any, for future work and international coöperation to be considered as coming from the United States at the Cambridge meeting.

(*c*) Suggestions, if any, for national coöperation.

The meeting of the American Section will be held about January 1, 1925, at the National Research Council in Washington, immediately following the meeting of the American Astronomical Society in affiliation with the American Association for the Advancement of Science. Such reports and suggestions as are adopted at that time will be forwarded to the secretary of the International Astronomical Union for distribution with reports from other countries some months in advance of the meeting of the Union.

Following is the list of committees of the American Section, the numbers corresponding to those of the international committees:

3. *Committee on Notation, Units, and Economy of Publication.*—W. J. Humphreys, *Chairman;* R. G. Aitken, Benjamin Boss, E. B. Frost, Frank Schlesinger.
4. *Committee on Ephemerides.*—W. S. Eichelberger, *Chairman;* E. W. Brown.
8. *Committee on Meridian Astronomy.*—Benjamin Boss, *Chairman;* F. B. Littell, J. G. Porter, R. H. Tucker.
12. *Committee on Solar Physics.*—C. E. St. John, *Chairman;* C. G. Abbot, Philip Fox, O. J. Lee.
14. *Committee on Standards of Wave-Length and Tables of the Solar Spectrum.*—H. D. Babcock, *Chairman;* Sebastian Albrecht, Keivin Burns, W. F. Meggers.
18. *Committee on Wireless Determination of Longitudes.*—Captain Edwin T. Pollock, *Chairman;* William Bowie, W. W. Campbell, J. J. Carty.
19. *Committee on Variation of Latitude.*—F. E. Ross, *Chairman;* W. D. Lambert, A. C. Lawson, F. B. Littell, Frank Schlesinger.
20. *Committee on Asteroids, Comets, and Satellites.*—A. O. Leuschner, *Chairman;* E. W. Brown, E. B. Frost, J. H. Metcalf, G. H. Peters, H. C. Wilson.
22. *Committee on Meteors.*—C. P. Olivier, *Chairman;* Willard Fisher, G. P. Merrill.
24. *Committee on Stellar Parallaxes.*—Frank Schlesinger, *Chairman;* W. S. Adams, H. D. Curtis, Philip Fox, O. J. Lee, J. A. Miller, S. A. Mitchell, H. N. Russell, Harlow Shapley, Frederick Slocum, Adrian van Maanen.
25. *Committee on Stellar Photometry.*—F. H. Seares, *Chairman;* R. H. Baker, J. A. Parkhurst, Harlow Shapley, Joel Stebbins.
26. *Committee on Double Stars.*—R. G. Aitken, *Chairman;* W. J. Hussey, H. N. Russell, G. Van Biesbroeck.
27. *Committee on Variable Stars.*—Harlow Shapley, *Chairman;* Leon Campbell, R. S. Dugan, F. C. Jordan, P. W. Merrill, C. L. Stearns, Joel Stebbins, R. E. Wilson.
28. *Committee on Nebulae.*—V. M. Slipher, *Chairman;* S. I. Bailey, E. P. Hubble, W. H. Wright.
29. *Committee on Spectral Classification of Stars.*—W. S. Adams, *Chairman;* Annie J. Cannon, R. H. Curtiss, P. W. Merrill, H. N. Russell, Harlow Shapley, W. H. Wright.
30. *Committee on Stellar Radial Velocities.*—W. W. Campbell, *Chairman;* W. S. Adams, R. H. Curtiss, E. B. Frost, J. H. Moore, V. M. Slipher.

## THIRTY-SECOND MEETING OF THE AMERICAN ASTRONOMICAL SOCIETY.

*(Continued from page 564.)*

### VARIABLE STARS AND THE AMATEUR OBSERVER.

By Leon Campbell.

This paper attempted to show in what way the enthusiastic and energetic amateur astronomer might add to the sum total of scientific knowledge. Long-period variables, on account of their large range and slow variations, are well suited to the skill and requirements of the amateur observer. Continuity of observation for these and many of the irregular variables is a great desideratum. Due to the fact that observers are situated in widely scattered longitudes and latitudes, not only can stars over the whole visible heavens be carefully watched, but difficulties arising from cloudy conditions can be well overcome. In such instances as the rapid rise of stars of the SS Cygni type it is highly advantageous to have observers who can secure observations during the whole of one astronomical day.

As far as observations being contributed to Harvard are concerned, the total for the past twelve months has passed the 35,000 mark. Of these, 23,000 have been contributed by members of the American Association of Variable Star Observers, with observers situated in nearly all parts of the world, nearly 10,000 have been contributed by the newly organized French Variable Star Observers, and the balance by individuals not directly connected with these organizations. Over 400 variable stars are contained in the observing list, including such irregular variables as SS Cygni, SS Aurigae, U Geminorum, R Coronae Borealis, RY Sagittarii, and R Scuti. Very few of the sudden variations in these stars escape detection by some one of the hundred or more observers taking part in this work, and only by keeping close watch on these stars can we hope to add to our knowledge of them.

Numerous slides illustrating the telescopic equipment of many of the observers were shown, as well as others depicting the light-curves of several of the more interesting and irregular variables.

It is clearly evident that the amateur variable star observer has taken, and is continuing to take, an important part in the solution of the variable star problem. Even with very moderate equipment there are numerous stars which demand the untiring efforts of the amateur. Promptness in publication of results is very desirable and the professional astronomer can hardly get along without the valuable data now being obtained by the amateur observer.

## DEDUCTIONS REGARDING THE RECENT SUN-SPOT MINIMUM.

From Observations with the Photoheliograph of the U. S. Naval Observatory.

By George H. Peters.

The following determination of the date of the recent sun-spot minimum is based upon observations made with the 40-foot horizontal photoheliograph of the U. S. Naval Observatory. This instrument is of 5-inches aperture producing a solar image about 4¼ inches in diameter. These photographs are made daily, the weather permitting, at about noon.

For the fiscal year ending June 30, 1923, 253 photographs were obtained, showing sun-spots on 123 of these photographs. For the present fiscal year, 1924, photographs were made on 254 days, upon which spots were observed on 134 days.

The data obtained from these observations, computed monthly, are given in the form of a chart and also presented in tabular form. No account has been taken of the varying length of the different months.

The principal points or ordinates, on the chart, represent the monthly percentage of days showing the presence of spots, with respect to the number of days observed. The relative dimensions of the spots or groups when observed are not considered here. The ratios given in the table are a determination of the percentage of days observed per month when no spots or groups appear upon the sun's visible disc.

It was stated in the annual report of the Superintendent of the Naval Observatory for 1923 that a minimum of the sun-spot cycle was indicated towards the end of February of that year, although future observations might possibly modify that date. Our later observations covering the fiscal year ending June 30, 1924, show a nearly equal minimum indicated during the latter part of August, 1923. Between February and August, 1923, a slight average monthly increase was noted when spots were observed.

It might be concluded therefore that the latter part of February, 1923, was the beginning of the sun-spot minimum, which ended about six months later. Consulting the chart the middle of this period would fall in the early part of June, 1923.

September, October and November, 1923, show a decided increase in the relative number of days when spots were observed. December, 1923, January, February and March, 1924, show a greater freedom from spots; while April shows a considerable increase, with a sharp increase in May. From here on the curve rapidly ascends. June, 1924, is the first month for some time when our observations show no days with the sun free from spots.

MINIMUM SUN-SPOT DATA, 1923-24, U. S. NAVAL OBSERVATORY.

| Date | Photos | Days Spots | No Spots | Percentage Days No Spots |
|---|---|---|---|---|
| 1922 Dec. | 15 | 11 | 4 | 26.7 |
| 1923 Jan. | 15 | 5 | 10 | 66.3 |
| Feb. | 15 | 3 | 12 | 80 |
| Mch. | 20 | 5 | 15 | 75 |
| Apr. | 21 | 10 | 11 | 52.4 |
| May | 24 | 7 | 17 | 70.8 |
| June | 26 | 15 | 11 | 42.3 |
| July | 25 | 7 | 18 | 72 |
| Aug. | 19 | 3 | 16 | 84.2 |
| Sept. | 24 | 21 | 3 | 12.5 |
| Oct. | 25 | 22 | 3 | 12 |
| Nov. | 20 | 14 | 6 | 30 |
| Dec. | 24 | 6 | 18 | 75 |
| 1924 Jan. | 18 | 7 | 11 | 61.1 |
| Feb. | 19 | 6 | 13 | 68.4 |
| Mch. | 23 | 6 | 17 | 74 |
| Apr. | 19 | 9 | 10 | 52.6 |
| May | 18 | 13 | 5 | 27.8 |
| June | 20 | 20 | 0 | 0 |

## RADIATION FROM THE DARK HEMISPHERE OF VENUS.

BY EDISON PETTIT AND SETH B. NICHOLSON.

Radiation from the dark hemisphere of Venus was measured with the vacuum thermocouple attached to the 100-inch reflector on the 22nd and 14th day before, and on the 5th, 6th, 7th and 14th day after the inferior conjunction which occurred on July 1st. Both deflection and drift-curves were obtained.

The drift-curves were obtained by causing the planet to drift across the thermocouple receiver by means of the right ascension slow motion, and driving the galvanometer registering device at the same time. These curves show that the radiation from the planet measured along a diameter passing through the middle of the crescent is a maximum over the crescent, then falls to about 20 per cent of the maximum when the dark part of the disk is reached, and remains at nearly this same value between the terminator and the dark limb. Similar curves obtained with a thin glass screen show that almost none of the radiation from the dark side of the planet is transmitted, and only 1/5 of it is transmitted by a fluorite screen.

Thus we have radiation from the dark side of Venus of long wavelength which reaches us almost entirely through the atmospheric transmission band 8 to 14$\mu$. The amount of radiation which is emitted by the dark side at this phase is three times greater than the amount sent us by the bright crescent. The radiometric magnitude of the planet at inferior conjunction is —4.8, which is 0.8 of a magnitude brighter than its radiometric magnitude at superior conjunction.

Two methods of estimating the temperature of emission of the radiation from the dark side agree in assigning a value near 250° C

absolute. This is consistent with what might be expected from radiation emitted by a cirrus cloud covered atmosphere.

When a curve taken 14 days before inferior conjunction is compared with one taken 14 days after inferior conjunction it is found that they are nearly identical. In fact the part of the curve over the dark portion of the disk is only 8 per cent higher after inferior conjunction than before. Deflections taken at the center of the disk confirm this.

Since different comparison stars were used on the two dates this result depends on a knowledge of their radiometric magnitudes closer than eight hundredths. If this difference be real it indicates a difference in temperature of about 5° C. While the quantities to be measured are large, the difference is very small, and will require considerable observing to determine its sign and value. If future observations confirm these results, direct rotation will be indicated.

The fact that the drift-curves over the dark part of the planet show a nearly uniform distribution of radiation also points to uniform temperature. Again, the amount of planetary heat radiated toward the earth at superior conjunction is nearly the same as that radiated at inferior conjunction. These three facts of observation indicate a nearly uniform temperature over the planet's surface, both on the illuminated and dark hemispheres.

## A TEST FOR LIGHT DEFLECTIONS OBSERVED AT ECLIPSES.

By Charles Lane Poor.

The mere fact that photographs taken during a total solar eclipse show a bending of light rays does not, of itself, prove the Einstein theory. Such bending may be due to the Einstein effect, or may be due to one of several perfectly natural causes: refraction of light through the masses of matter surrounding the sun, or abnormal refractions in the atmosphere of the earth. Until the possible effects of all such natural causes have been completely eliminated, the observed light deflections during an eclipse cannot be taken as proof of the relativity theory.

The effects of abnormal refraction in the earth's atmosphere may be very similar in character to the so-called Einstein effect. The higher the sun in the heavens at the time of the eclipse, the more nearly will the effects of abnormal refraction approach the Einstein effect. In fact, in the ideal case the two effects (abnormal refraction and Einstein) follow practically the same law. If, at the time of an eclipse, the sun be in the zenith of the observer and the atmosphere be perfectly quiet, then the shadow of the moon would cause a funnel of cool air to form, coolest along the vertical axis of the shadow. A ray of light from a star would, therefore, pass from warmer air to the cooler air of the shadow axis in reaching the photographic plate, and such a ray would be refracted, or would show a bending in the opposite direction to that

of ordinary refraction. The amount of such abnormal refraction would depend upon the distance of the star from the axis of the shadow; and the law by which the amount of such refraction would decrease with the distance of the star from the centre of the shadow would be the same as that for the so-called relativity effect. A difference in temperature of only a very few degrees between the air at the axis of the shadow and that at the edges would cause a bending of the rays fully as large as that called for by Einstein. This abnormal effect might be larger than and completely mask the ordinary refraction.

There is rather a simple way of testing an eclipse plate for the presence of such abnormal refraction. Such a plate shows not only the image of the stars, but also the image of the moon. Various points on the edge of the moon might be measured in the same way as the star images. Such moon measures could be reduced in a manner entirely similar to that used for the stars, applying the same corrections for orientation, scale value, differential refraction, etc. From these measures could thus be obtained the values for various diameters of the moon and such measured, or observed diameters could be compared with that calculated from the best obtainable observed diameters. If the various diameters of the moon, so measured, show no distortion and agree with the calculated value, then this check would be fairly conclusive evidence that any star deflections obtained are caused by some cosmic action, are due to some cause or causes at a distance farther from the earth than the moon. On the other hand, if the moon diameters show distortions, or a value different from the calculated value, it would be good evidence that any other observed deflections are also of terrestrial origin, either instrumental or atmospheric.

In attempting, however, to apply such a test to a plate taken in the way ordinarily used in the Einstein test, certain difficulties are met. The usual procedure is to expose the plate for some 50 to 60 seconds in order to get measurable images of the fainter stars. During this long exposure the coronal light eats into the edge of the moon, and the moon itself moves; and for these reasons such lunar image is practically worthless for exact measurement. Further, the star images on the plate are themselves displaced, either through natural causes or the Einstein effect, and such images, therefore, cannot be used to obtain satisfactory plate constants: a scale value determined from such star images would be affected by the mean or average displacement of the star images used. To satisfactorily apply the proposed test it is essential that the eclipse plate shall contain the following elements:

*(a)*. A star field, independent of the eclipse and the eclipse field, from which the plate constants can be determined.

*(b)*. Measurable moon images taken during totality.

*(c)*. The eclipse field, taken during totality, from which the star deflections can be obtained.

To obtain these essential elements on the eclipse plate a program such as the following must be adopted:

1. On the night previous to the eclipse, the plate should be suitably exposed to a check field, selected so as to give a wide distribution of stars over the plate in order that accurate plate constants may be secured. After such exposure the plate should be left, undisturbed, in the camera.

2. During totality the plate should be suitably exposed to the eclipse field in the ordinary manner of the Einstein test.

3. Without being removed from the camera, the plate should be moved or shifted by a small amount, and a very short exposure (one second or less) made. This exposure should give a clear and measurable image of the moon.

Such a plate would have the following data upon it: the star images of the check field, the star images of the eclipse or Einstein field, the central over-exposed image of the moon, and say two moon images made with very short exposures.

In addition to this eclipse plate there should be, of course, the so-called comparison plate of the ordinary Einstein test: that is, a plate showing the stars of the eclipse field but taken at a different season of the year. There should also be a plate of the check field taken on the same night that the eclipse plate was exposed to that star field, but such additional plate should not be exposed during totality. This plate could be used to check the eclipse plate for film distortion.

The measurement and reduction of the plates should be carried out by standard methods and in a manner similar in all respects to that in which former eclipse plates have been handled. The general procedure should be as follows:

1. The scale value and the plate constants for the eclipse plate should be determined from the stars of the check field.

2. Numerous points on the special image of the moon should be selected and should be measured and the measures reduced in a manner entirely similar to that used for star images. From such measures and from such points, after the application of the usual corrections, can be obtained the various diameters of the moon.

3. These observed or measured diameters of the moon should be directly compared with the best obtainable observed diameter as determined from the data in the *Nautical Almanac,* and the distortion of the moon, if any, thus found.

4. The star displacements should be obtained by the usual procedure and methods used in former Einstein tests.

Such a complete operation ought to give a very good check on the cause, or causes of the star deflections heretofore found: it ought to show up any plate distortions, instrumental errors, or atmospheric ab-

normal refractions. By this method of utilizing the moon, one ought to be able to localize the cause of the light deflections; to determine whether such cause lies between the observer and the moon, or whether it lies beyond the moon at some point on the infinitely long path of the light ray.

## STAR-TRAILS IN THE CASE OF A TELESCOPE WHOSE POLAR AXIS MAKES THE ANGLE $\gamma$ WITH THE EARTH'S AXIS.

By John M. Poor.

Let $\gamma$ be the angle between the earth's axis and the polar axis of an equatorial telescope, taken with sufficient generality as less than 90°. Let $\delta$ be a star's declination whose maximum value is 90° and let $\theta$ be the star's hour-angle reckoned from the hour circle passing through the instrumental pole and varying from 0° when the earth's pole lies between the star and the pole of the instrument to 360° with the star's diurnal motion. Then the usual rectangular coördinates of a star referred to a plate center whose instrumental declination is $\delta$ are given by the expressions

$$x = +\tan\gamma\,\frac{\sin\delta\sin\theta - \cos\delta\tan\tfrac{1}{2}\gamma\sin\theta\cos\theta}{1+\cos^2\delta\tan\gamma\tan\tfrac{1}{2}\gamma\sin^2\theta}$$

$$y = -\tan\gamma\,\frac{\cos\theta + \sin\delta\cos\delta\tan\tfrac{1}{2}\gamma\sin^2\theta}{1+\cos^2\delta\tan\gamma\tan\tfrac{1}{2}\gamma\sin^2\theta}$$

From these expressions a somewhat lengthy elimination of $\theta$ gives an equation of the form

$$Ax^4 + (By^2+Cy+D)\,x^2 + Ey^4 + Fy^3 + Gy^2 + Hy + K = 0$$

Solving for positive values of $x^2$ only, ambiguity of sign before the radical disappears while the expression under the radical sign may be factored, resulting in a solution of the form

$$x^2 = (y-\rho)\,\sqrt{Py^2+Qy+R} - (By^2+Cy+D)$$

The quantities $A, B, C, \ldots K, P, Q, R, \rho$, and $S$ and $T$ used below are functions of $\delta$ and $\gamma$, and are not seriously complicated.

The equation for the slope of the curve at any point has been found. The condition for a maximum or minimum in $y$ becomes $x=0$, and for a maximum or minimum in $x$ results in an expression of the third degree in $y$ which has thus far resisted attempts to factor in its general form. This may be written

$$Py^3 + Qy^2 + (R+S)y + T = 0$$

Special cases of this equation are easily solved.

Two well known cases of interest are for $\delta = 90°$ and $\delta = 0°$.

The expressions for the rectangular coördinates give for $\delta = 0°$

$$x = +\tan\gamma \sin\theta$$

$$y = -\tan\gamma\cos\theta \text{ or } x^2 + y^2 = \tan^2\gamma$$

while the general equation of the fourth degree gives when $\delta = 0°$

$$x^4 + x^2(1 + y^2[\cos\gamma]/[\cos^4 \tfrac{1}{2}\gamma]) = (y^2/4\cos^4 \tfrac{1}{2}\gamma)\ (\sin^2\gamma - y^2\cos^2\gamma).$$

It may be of interest to compare this with the result obtained for the case in which $\gamma$ is limited to small values by Professor Arthur Searle, as given by Professor E. C. Pickering in Vol. XI of the *Memoirs of the American Academy of Arts and Sciences*, page 201, where after correction of an obvious numerical error and interchange of his $x$ and $y$ to agree with the coördinate system here employed we obtain the expression

$$x^2 = (y^2/4\cos^4 \tfrac{1}{2}\gamma)\ (\sin^2\gamma - y^2)$$

which includes the terms of lowest order in the general expression above.

Discussion of the details of the solution and some characteristics of the "star-trail curves" with numerical illustrations will be given elsewhere later.

## DISTORTIONS ON SPOTTED PHOTOGRAPHIC PLATES.

By Frank E. Ross.

The field of usefulness of desensitizers in astronomical photography is somewhat limited, but perhaps of widening extent. So far its most important application has been in parallax work, as at Allegheny. In applications of this kind, only a small portion of the plate is desensitized, which at once raises the question, to what extent are harmful distortions introduced? These have been measured in the case of spots of varying sizes, from which the following results have been gleaned. If the desensitized area is 45 mm in diameter, there is a small area at the center, about 8 mm in diameter, which is entirely free from distortion of any kind. From the boundary of this area to the edge of the desensitized spot, the distortion increases steadily to a maximum of about 8$\mu$, accompanied by an increase in the probable error. Thus, for this case, the maximum error in a measured distance is 16$\mu$, distances being increased. The distortion falls abruptly to zero as soon as the edge of the spot is passed. The phenomenon in general is not dependent upon the desensitizer, but is due merely to the wetting of the film, and is therefore controlled to a certain extent by the hardness of the gelatin. It will be understood that the distortion is present in the film at the time of exposure, but is ironed out on development and washing, so that measured distances are too small. In the case of a smaller spot, 4 mm in diameter, the distortions were much larger, the

maximum stretching taking place at the center. The important conclusion to be drawn from these results is that, for accurate measurement, the desensitized area should not be less than about 45 mm in diameter, and in addition the object centered on the spot to a fair degree of accuracy.

The photographic qualities of desensitized plates or areas are exceedingly favorable. There is found a decrease in fog and graininess and an increase in resolving power and contrast. The best results have been obtained by bathing for only 10 seconds in a one per cent solution of copper sulphate, giving a reduction of speed of about 25 times. Longer bathing, while decreasing the speed also decreases the contrast. A decrease of speed of about 150 times seems to be the limit with desensitizers of the copper sulphate type. If greater decrease is desired oxidizing desensitizers of the chromic acid type may be used, which will give a decrease of speed of ten thousand times or more, depending on the concentration. There is a third type of desensitizer, of which phenosafranine and pinacryptol green are well known examples, which also will give any desired degree of desensitization. These, in common with copper sulphate, do not reduce the latent image. If this is desired, as in the case of an over-exposed plate or image, chromic acid may be used.

## NOTES ON THE SUN-SPOT SPECTRUM.

By Henry Norris Russell.

Lines of many elements for which the spectroscopic series and energy relations have recently become known, have been examined in the sun-spot spectrum. As is well known, lines originating in the lowest energy levels of the neutral atom are characteristically strengthened in spots, and those arising from higher levels less affected. It is now found that in multiplets of lines, all of which arise from the same energy level, the weaker members are strengthened in the spot spectrum to a much higher degree than the stronger members. This may be explained as an effect of "saturated" absorption. For the strong lines, which are due to the more probable quantum changes in the atom, the absorption in the reversing layer is so great that a large increase in the number of absorbing atoms present alters the strength of the line very little. For the weak components, due to improbable transitions, absorption under ordinary conditions is incomplete, and the strengthening in the spots is noteworthy. Examination of the lines of several elements indicates that the absorption is in all cases nearly saturated for lines of intensity as great as 8 on the Rowland scale (except for winged lines), and conspicuously unsaturated for those of intensity 1 or less. Ultimate lines of suitable strength show conspicuous change in the spot, even at $\lambda 4000$.

For iron, almost all the lines are nearly saturated except for components corresponding to very improbable quantum transitions, and to very faint arc lines. For titanium, the strongest lines are saturated and the faint ones conspicuously unsaturated. For vanadium, the stronger lines are unsaturated and the faint ones show only in the spots. For scandium, only the strong lines of the arc spectrum appear, and these are almost confined to the spots. This suggests strongly that iron is very abundant in the solar atmosphere, scandium very rare, and titanium and vanadium intermediate in abundance. It is probable that much information concerning the relative proportion of the different elements in the solar atmosphere can be derived in this way.

(It may be added, that observations made since the meeting indicate that among the enhanced lines of iron, which are weakened in the spots, the weakening is greatest for the fainter members of recently recognized multiplets.)

## ON PRESSURE AND CONVECTION CURRENTS IN THE ATMOSPHERES OF THE SUN AND STARS.

By C. E. St. John, W. S. Adams and H. D. Babcock.

In determining the pressure in the sun's atmosphere the effects depending upon motion, general relativity, and difference in level may be eliminated by a suitable choice of lines. Pressure in the sun's atmosphere $= (\Delta\lambda_2 - \Delta\lambda_1)/(c_2 - c_1)$ where the $c$'s are pressure coefficients per atmosphere and the $\Delta\lambda$'s are differences in wave-length between the sun and the arc in vacuum. The resulting pressure is $0.13 \pm 0.06$ atmosphere.

High dispersion spectrograms taken in 1909 and 1910 (1.4A per mm at $\lambda$4300) afford data for comparing by similar methods the pressure in Sirius, Procyon and Arcturus with that of the sun. The results show that the pressures in the atmospheres of these stars are low and of the same order as in the sun.

Relative displacements of high and low-level lines were compared by forming two groups of arc lines, one showing heights of 600 km or more in the flash spectrum, and another under 600 km with the following results.

| | No. of Lines | | High level *minus* | Equivalent | Temper- | |
|---|---|---|---|---|---|---|
| | High level | Low level | Low level | Velocity | atures | Types |
| Sirius | 64 | 113 | 0.018 A | 1.20 km | 8800° K | A2 |
| Procyon | 73 | 222 | 0.010 | 0.67 | 5400 | F3 |
| Arcturus | 80 | 666 | 0.005 | 0.34 | 3900 | K0 |
| Sun | | | 0.003 | 0.20 | 5800 | G0 |

It may be fairly assumed that convection currents are favored by high temperatures and low pressure. The displacements interpreted as Doppler effects are in agreement with this assumption. Differences

between the displacements of enhanced and arc lines are of the same order of magnitude as between high and low-level lines and may be attributed to the same causes, as in the flash spectrum the enhanced lines rise to greater heights than arc lines of the same solar intensity.

The increase of the downward drift of the high-level lines with temperature offers a possible explanation of the K-term in B-type stars whose radial velocities are obtained from lines of very high level.

## SOME CHANGES ON MARS IN 1924.

By E. C. Slipher.

The purpose of the paper was to show some of the changes occurring on Mars in 1924 as recorded by the Lowell Observatory photographs of the planet. To portray the development of the dark markings in the southern hemisphere of Mars with the advance of summer there, two sets of comparable photographs made at different times in the Martian season were arranged on the same slide. On each slide the two sets of photographs are of practically the same Martian longitude. The copies were matched in density and contrast as nearly as possible so as to preserve the true relative intensity of the markings on the two dates. All the photographs were made with the 24-inch refractor, using the same color-filter and Cramer's Isochromatic plates.

These slides give added evidence that orderly seasonal changes take place throughout the dark markings of the planet, approaching maximum development at a seasonal date corresponding to about our July 1. Also that temporary phenomena occur that appear to be meteorologic in character.

## THE RADIAL VELOCITY OF ADDITIONAL GLOBULAR STAR CLUSTERS.

By V. M. Slipher.

In the course of the observation of star clusters for radial velocity, determinations have been made of two additional condensed clusters, the results from which may be of interest at this time. These are situated in a widely different portion of the sky from those previously observed, and so have particular value in the extension of the observed objects to a new portion of the sky. However, owing to the very localized distribution of such objects the distribution of the observed ones naturally must be very much limited. As is well known, globular clusters are distributed in definite relation to the galaxy, but they are far from uniformly scattered along it.

The two objects that are the subject of the present note are

N. G. C. 1851, R. A. $5^h\ 11^m$, Decl. $-40°\ 8'$
N. G. C. 1904, R. A. $5^h\ 20^m$, Decl. $-24°\ 36'$

One spectrogram has been secured for each of these. The radial velocities yielded by them are N. G. C. 1851, +300 km, and N. G. C. 1904, +200 km. Thus these objects are both receding from the sun, and in this respect differ from the majority of those previously observed, which had generally (but not always) shown velocities of approach. These objects, as was hinted by some of those previously observed, show a disposition for neighboring clusters to possess comparable velocities.

It is, of course, possible to get the motion of the sun with reference to these observed clusters. The resulting direction and speed of the sun is not much changed by the addition of these two clusters from a new area of the sky.

The considerable magnitude of these two positive velocities reduces the mean velocity of the seventeen clusters, thus far observed at the Lowell Observatory, to —38 km per second. The average velocity, disregarding sign, becomes now about 135 km per second. This is seen to be very considerably higher than the average radial velocity of the stars, but on the other hand very much lower than that of the spiral nebulae.

It is, of course, desirable to get velocities of still other globular clusters, with particular regard to as wide a distribution as possible about the sky, in order to make the motions a more secure basis for further general considerations.

## NOTE ON THE VARIATION OF U CEPHEI.

By Harlan True Stetson.

The question of the reality of certain suspected variations of a secondary character, raised by the measurements of earlier plates of U Cephei with the thermo-electric photometer, has been further investigated by the measurement of plates recently taken of this variable during minimum. A record plate was secured by Professor Slocum of the Van Vleck Observatory on the night of November 3, 1923, and gave a series of sixty-nine images of the variable and comparison stars taken at approximately five minute intervals throughout the night. When this was measured with the thermo-electric photometer, certain irregularities, secondary fluctuations, seemed to persist which were in general accord with the results from previous observations. Plates taken and measured by Mr. E. F. Carpenter during the approximately constant phases also indicated a short-period fluctuation. These fluctuations in magnitude are considerably in excess of plate errors, as can be judged from investigations especially made for the purpose and concerning which reports have already appeared in print.

The cause of such relatively rapid fluctuations appears obscure but may well be due to small variations within the star itself. It is suggested that a further check on the reality of these suspected secondary

variations could best be made by securing photographs in duplicate for each minimum studied. The form of particular light-curves was exhibited on lantern slides. Further discussion will appear elsewhere.

## SYSTEMATIC ERRORS IN RADIAL VELOCITIES DUE TO SECONDARY COMA OF THE CAMERA LENS.

By Otto Struve.

The determination of systematic errors in radial velocity work is of great importance on account of their influence upon the K-term, discovered by Professor W. W. Campbell.

The fact that radial velocities determined at the Yerkes Observatory with the Bruce spectrograph and with the dispersion of one prism are subject to a systematic error, was pointed out several years ago by Miss Wickham. From measurements of 32 plates of $\epsilon$ Aurigae and of $\alpha$ Cygni, she concluded that lines of shorter wave-length, averaging $\lambda$4185, show a systematically greater velocity than lines of longer wave-length, averaging $\lambda$4520. This difference amounted to as much as +4.48 km/sec.

The same effect was also noticed by the writer from measurements of several stars having well defined lines. The average residuals from the true velocity for eleven stellar lines, distributed over the whole measured part of the spectrum, are given below.

| $\lambda$ | Reading | $\Delta$ Vel. | $\Delta R$ |
|---|---|---|---|
| 4045 | 28.38 | +5.5 km/sec. | +39 |
| 4063 | 29.32 | +4.0 | +28 |
| 4077 | 30.06 | +3.0 | +24 |
| 4173 | 39.09 | +5.6 | +36 |
| 4338 | 41.66 | +2.6 | +15 |
| 4395 | 43.82 | +1.9 | +10 |
| 4468 | 46.43 | +4.8 | +24 |
| 4481 | 46.86 | +0.4 | + 4 |
| 4501 | 47.54 | −1.9 | − 9 |
| 4563 | 49.56 | 0.0 | 0 |
| 4572 | 49.81 | −2.8 | −13 |

The residuals $\Delta R$ are given in ten thousandths of a millimeter. If these residuals are plotted against the readings $R$, expressed in whole millimeters, they determine roughly a straight line which can be expressed by the equation:

$$9R + 5\Delta R - 429 = 0$$

This systematic error, which depends on the position of the line on the plate, is apparently due to the secondary coma of the camera lens. The lens chiefly used until 1923 in connection with the Bruce spectrograph was a triplet designed by Professor C. S. Hastings, which gave good definition over a large portion of the field. However, the secondary coma was not entirely removed and this coma produced an appreci-

able displacement of over-exposed comparison lines in the direction away from the center of the plate. This causes an apparent displacement of stellar lines, as these are not affected by the coma; the displacement being positive in the violet and negative in the blue regions. The central ray of the Bruce spectrograph is at λ4500 and the majority of measured lines lies on the violet side of this. Therefore the effect of coma will always tend to make the measured velocities larger than they really are, thus tending to increase the well known K-term.

For investigating this systematic error, spectrograms with the dispersion of one prism were obtained of the spark alone, giving a long exposure through the comparison window and a short one through the star window, and vice versa. Such plates were obtained with the Hastings camera lens, known as $B^2$, and also with a new camera lens recently computed by Professor F. E. Ross and figured by Mr. McDowell. The plates were measured independently and on different machines by Professor G. Van Biesbroeck, Miss Mary Howe, and the writer. The results, collected below, indicate clearly the presence of the effect due to coma in the case of the $B^2$ lens. This effect is practically absent in the case of the new Ross lens R, although there seems to exist a small systematic error necessitating a constant correction of about +0.5 km/sec. The values of $\Delta R$ for the $B^2$ lens plotted against the readings determine the same straight line as given by the star plates, which is a confirmation of our hypothesis as to the origin of the error. At λ4500 the correction is zero, which is to be expected since this is the center of the optical system. The equation of the straight line can be used for determining the corrections to the measurements of each stellar line. This correction amounts to —6.1 km/sec. at λ3900 and to +4.5 km/sec. at λ4856. For a star in which eleven lines were measured between the wave-lengths 4045 and 4572 the total correction is about —2 km/sec.

The existence of this systematic error shows sufficiently clearly that a thorough discussion of all available radial velocities is needed before an attempt can be made to explain the K-effect from a physical point of view.

| | | $B^2$ lens | | R lens | |
|---|---|---|---|---|---|
| λ(average) | Reading | $\Delta R$ | Δ Vel. | $\Delta R$ | Δ Vel. |
| 3910 | 20.52 | +40 | +4.9 km/sec. | —5 | —0.6 km/sec. |
| 3965 | 23.94 | +49 | +6.3 | —6 | —0.7 |
| 4004 | 26.15 | +28 | +3.8 | 0 | 0.0 |
| 4150 | 33.58 | +35 | +5.4 | —4 | —0.6 |
| 4291 | 39.80 | +13 | +2.2 | —4 | —0.7 |
| 4377 | 43.16 | +12 | +2.2 | —5 | —0.9 |
| 4464 | 46.28 | + 8 | +1.6 | —3 | —0.6 |
| 4520 | 48.18 | + 8 | +1.6 | 0 | 0.0 |
| 4575 | 50.06 | — 2 | —0.4 | +2 | +0.4 |
| 4637 | 51.53 | —15 | —3.3 | +1 | +0.2 |
| 4736 | 53.57 | —28 | —6.5 | —5 | —1.2 |

## ON THE MASS RATIOS OF BINARY STARS.

By Edwin B. Wilson and Willem J. Luyten.

From lack of data the assumption has often been made that the masses of the components of a binary system tend toward equality. Analysis of the data for 69 stars, at present at our disposal, shows that the logarithms of the ratios, taken both ways, distribute themselves more or less in an error-curve with a mean of 0.0 and a standard deviation of 0.26.

The logarithms of the individual components of 15 visual binaries follow an error-curve with a standard deviation of 0.36. If we should assume that the 69 binaries, whose mass ratios are known, originated by random mating of the visual components we would expect a standard deviation of 0.50. Instead we find the surprisingly small value 0.26, and it would seem as if there really existed a tendency toward equality.

It is obvious, however, that among the 69 binaries whose ratios have been observed, the very large ratios have been selectively excluded as a disparity in mass almost invariably correlates to a larger difference in luminosity. We have no *a priori* knowledge of this chance of discovery, and it seems best to determine it from a comparison of the two values for the standard deviation obtained above. Measured in terms of the discovery chance for a binary of equally massive components, we find that the probability of detection of a binary whose logarithmic mass ratio is $x$, equals $e^{-5.4x^2}$.

Considering the correlation between mass and luminosity this value appears reasonable.

## ON THE MOTIONS, MEAN DISTANCE AND LUMINOSITIES OF THE CLASS O STARS.

By Ralph E. Wilson.

From studies of the proper motions of 84 and the radial velocities of 49 of these stars it is shown that, statistically considered, the dispersion in distance about a mean represented by a parallax, $\pi = 0''.0013$, is relatively small and that, therefore, there must exist among them a considerable dispersion in absolute magnitude, in direct contrast to what should be expected on the basis of the giant-dwarf theory of stellar evolution.

This range in luminosity cannot be wholly explained as the effect of errors, either systematic or accidental, in the proper motions, but may be reasonably explained on Eddington's theory that absolute magnitude is a direct function of mass. If this is the true explanation of the apparent dispersion in luminosity, the parallaxes of the individual stars

computed upon the basis of a mean absolute magnitude must be considerably in error, especially for the very bright and very faint apparent magnitudes. This conclusion is supported by the fact that the trigonometric parallaxes of the brighter stars are in general negative, whereas those of the fainter stars are much greater than the values given on the assumption of constant mean luminosity.

The real motions of the Class O stars are large and the northerly declination they give for the apex of the solar motion may be explained either as the effect of the well-known asymmetry in the motions of the high-velocity stars or by systematic errors in the proper motions in declination.

## SOME NOTES ON SOLAR RESEARCH.

By Issei Yamamoto.

In 1923 when I was studying solar phenomena from the observed data of Mount Wilson Observatory, I found a peculiar relation between the distance of positive and negative magnetic poles and the maximum intensity of the magnetic field in the bipolar sun-spot. Generally the relation is linear, the field intensity increasing with the distance between the poles; but there is apparently a lower limit of the latter for a range of the former, so that the graphical form of the relation as a whole is more or less logarithmic.

On the other hand, I found a tendency of the distance between the magnetic poles to occur in a wider range if a spot is nearer the solar equator. The evidences are similar in both northern and southern hemispheres.

There is no logical connection between the above two phenomena. But, if we assume an hypothetical idea that the bipolarity of the sun-spot is a physical consequence of the velocity-changes between the successive layers of the solar atmosphere, then the first phenomenon will suggest a discontinuity of the circulating velocity in a certain depth of the atmosphere, and the second phenomenon seems to indicate gradual changes of the relative depths and the radial distribution of the layer-velocities according to heliographic latitudes. It seems to me that depths of the atmosphere considered herewith are beyond the range of penetration with modern spectroscopic or other instrumental powers, so that the evidences above mentioned cannot be examined otherwise than by heliographic study.

## TWO LONG-PERIOD SPECTROSCOPIC BINARIES.

By R. K. Young.

The need for knowledge of the spectroscopic binaries of long period is greater at the present time than that for those of short period because the observation of the former has lagged far behind. The reason for this state of affairs is that the latter class can be determined in shorter time and therefore appealed to observers more as interesting ones to observe. The following stars of relatively long period are two among a number placed by the writer on a program of observation some years ago.

$\beta$ Scuti, R. A. $18^h\,41^m.9$, Dec. $-4°\,51'$ (1900)
Visual Magnitude 4.5, Spectrum G6.

Seventeen observations of this star have been secured at this observatory with the one-prism spectrograph and measured on the Hartmann comparator. In addition ten observations secured at the Lick Observatory dating back to 1899 have been made use of in determining the period. As is so often the case, these early results are invaluable Two observations made at Bonn in 1913 have also been used. The elements given below are the result of a least-squares solution.

$$\begin{aligned} P &= 834 \text{ days} \\ T &= \text{J. D. } 2{,}422{,}480.9 \\ \gamma &= -21.9 \text{ km} \\ K &= 16.65 \text{ km} \\ e &= 0.35 \\ \omega &= 33°.9 \\ a \sin i &= 178{,}000{,}000 \text{ km} \\ m_1^3 \sin^3 i/(m+m_1)^2 &= 0.33\,\odot \end{aligned}$$

The probable error of a single plate as determined from residuals which these elements leave is $\pm 0.84$ km.

B. D. $66°878$, R. A. $14^h\,56^m$, Dec. $+66°\,20'$ (1900)
Visual Magnitude 4.9, Spectrum Mb.

This star is of interest on account of its late type. It is classified by Harvard as Mb and on the numerical system would be M6. So far as known, it is the latest type star for which an orbit has been determined. The only other M-type orbits are $\alpha$ Scorpii and $\alpha$ Orionis which are M2 and M1 types. The range in the velocity variation of these stars is so small as to render the elements of the orbits very uncertain.

The following elements are derived from 26 Victoria observations and five made at the Lick Observatory. The probable error of a single plate is 1.25 km which, though not so small as found for $\beta$ Scuti, is still satisfactory.

$$\begin{aligned} P &= 750 \text{ days} \\ T &= \text{J. D. } 2{,}422{,}065.0 \\ e &= 0.0 \\ K &= 6.67 \text{ km} \\ \gamma &= +6.85 \text{ km} \\ a \sin i &= 68{,}800{,}000 \text{ km} \\ m_1^3 \sin^3 i/(m+m_1)^2 &= 0.023\,\odot \end{aligned}$$

## THE OBSERVATION OF LUNAR OCCULTATIONS IN JANUARY AND FEBRUARY 1925.

**Communicated by L. J. COMRIE.**

The occasion of the total solar eclipse of 1925 January 24 is being utilised for a comparison of the moon's place with its tabular place in Brown's Tables. The observations on the day of the eclipse are, however, to be supplemented by others during two complete lunations, one immediately preceding and the other following the eclipse. Arrangements have already been made for meridian and photographic observations, and the general astronomical public is invited to coöperate by making accurate observations of occultations. The stars to be observed are those whose Besselian elements are given in the *American Ephemeris*, and which are occulted between 1924 December 27 and 1925 February 21. Observations of 7th and 8th magnitude stars not included in the *A. E.* list can also be reduced, but the observer should either identify his star at the time of observation, or else note roughly its position angle at the moment of immersion or emersion.

It is impossible to give predictions for every station in the United States, hence each observer should really make his own predictions. This is quite a simple matter, as a graphical method, such as that described by Rigge in POPULAR ASTRONOMY and also in a book* published less than a month ago, is sufficiently accurate. The accompanying predictions will, however, be of assistance to observers in the immediate neighborhood of the selected stations, and for others it will act as a guide in the preparation of a trial list, as a mere inspection of the Besselian elements is not always sufficient to determine whether or not a star will be occulted from a given place. For the benefit of observers in the western states it may be mentioned that predictions for Lick Observatory will appear in the December number of the *Publications of the Astronomical Society of the Pacific*.

A few remarks on the method of observing and the accuracy required may not be out of place. The latitude and longitude of the observer should be known to a tenth or at most two or three tenths of a minute of arc. During the progress of these observations the time piece used should be compared at least daily with radio or telegraphic time signals, in order that its rate and behaviour may be well known. The most convenient method of observing when a chronograph is not available is to start a reliable stop watch at the instant of the occultation, stopping it again a few seconds later at some definite time on the chronometer. The stop watch should not be allowed to run more than a few minutes at most, and it should not have any appreciable rate or variable starting error. By this means times may be recorded to 0.2 second, with a pos-

*William F. Rigge, *The Graphical Construction of Eclipses and Occultations.* Loyola University Press, Chicago, Illinois, 1924.

sible error, however, of 0.5 second.* Observers who do not possess stop watches should endeavour to record their times to the nearest second. It must be remembered that irregularities on the limb of the

| Date | | The Star's Name | Mag. | Immersion Eastern Time h m | Immersion P ° | Immersion V | Emersion Eastern Time h m | Emersion P ° | Emersion V |
|---|---|---|---|---|---|---|---|---|---|
| | | **HARVARD COLLEGE OBSERVATORY** | | | | | | | |
| Dec. | 29 | 42 Aquarii | 5.5 | 6 36 | 67 | | 7 44 | 248 | |
| Jan. | 3 | $\xi^2$ Ceti | 4.3 | 19 2 | 131 | | 19 34 | 174 | |
| | | **ALBANY, N. Y.** | | | | | | | |
| Dec. | 29 | 42 Aquarii | 5.5 | 6 36 | 63 | | 7 40 | 251 | |
| Jan. | 3 | $\xi^2$ Ceti | 4.3 | 18 50 | 122 | | 19 34 | 182 | |
| | | **NEW YORK CITY** | | | | | | | |
| Dec. | 29 | 42 Aquarii | 5.5 | 6 33 | 65 | 30 | 7 38 | 248 | 206 |
| Jan. | 3 | $\xi^2$ Ceti | 4.3 | 18 50 | 123 | 136 | 19 33 | 181 | 179 |
| | 12 | 227 B Cancri | 6.4 | 5 30 | 48 | 358 | 6 5 | 347 | 295 |
| | 22 | 15 Sagittarii | 5.3 | 5 56 | 113 | 155 | 6 58 | 265 | 301 |
| | 22 | 16 Sagittarii | 5.9 | 6 13 | 22 | 62 | 6 26 | 358 | 37 |
| | 26 | 70 Aquarii | 6.1 | 18 59 | 91 | 45 | 19 52 | 228 | 179 |
| | 29 | 117 G Piscium | 6.5 | 20 53 | 65 | 18 | 21 57 | 252 | 203 |
| Feb. | 2 | Aldebaran | 1.1 | 16 55 | 124 | 171 | 17 43 | 196 | 235 |
| | 3 | 119 Tauri | 4.9 | 22 4 | 156 | 118 | 22 33 | 194 | 150 |
| | 8 | $\psi$ Leonis | 5.6 | 20 26 | 132 | 184 | 21 32 | 252 | 298 |
| | 15 | 13 Librae | 5.7 | 3 51 | 123 | 141 | 5 11 | 289 | 288 |
| | 16 | 190 B Librae | 6.5 | Below Horizon | | | 1 39 | 315 | 272 |
| | | **SWARTHMORE, PA.** | | | | | | | |
| Dec. | 29 | 42 Aquarii | 5.5 | 6 35 | 68 | | 7 41 | 244 | |
| Jan. | 3 | $\xi^2$ Ceti | 4.5 | 19 0 | 141 | | 19 19 | 164 | |
| | | **WASHINGTON, D. C.** | | | | | | | |
| Dec. | 29 | 42 Aquarii | 5.5 | 6 34 | 70 | 35 | 7 41 | 242 | 198 |
| Jan. | 3 | $\xi^2$ Ceti | 4.3 | 19 0 | 141 | | 19 19 | 164 | |
| | 12 | 227 B Cancri | 6.4 | 5 23 | 67 | 14 | 6 14 | 334 | 280 |
| | 22 | 15 Sagittarii | 5.3 | 5 52 | 122 | 168 | 6 51 | 258 | 297 |
| | 22 | 16 Sagittarii | 5.9 | 5 58 | 44 | 89 | 6 33 | 337 | 18 |
| | 26 | 70 Aquarii | 6.1 | 19 0 | 96 | 49 | 19 51 | 219 | 168 |
| | 29 | 117 G Piscium | 6.5 | 20 52 | 72 | 23 | 21 59 | 245 | 194 |
| Feb. | 2 | Aldebaran | 1.1 | 16 52 | 128 | 180 | 17 36 | 192 | 238 |
| | 6 | 10 H Cancri | 6.1 | 21 38 | 34 | 73 | 22 20 | 340 | 3 |
| | 8 | 11 Leonis | 6.5 | Below Horizon | | | 18 17 | 263 | 315 |
| | 8 | $\psi$ Leonis | 5.6 | 20 23 | 139 | 193 | 21 22 | 245 | 295 |
| | 15 | 13 Librae | 5.7 | 3 47 | 133 | 155 | 5 4 | 281 | 284 |
| | 16 | 190 B Librae | 6.5 | Below Horizon | | | 1 33 | 261 | 308 |
| | | **CINCINNATI, OHIO** | | | | | | | |
| Dec. | 29 | 42 Aquarii | 5.5 | 6 20 | 57 | | 7 34 | 254 | |
| Jan. | 3 | $\xi^2$ Ceti | 4.3 | 18 20 | 111 | | 19 14 | 190 | |

moon may affect the time of an occultation by several tenths of a second, also that our uncertainty in the knowledge of even the best star places corresponds to a time uncertainty of several tenths of a second. It may also be remarked that a complete observation of both phases of

*An interesting discussion of the use of the stop watch in observing occultaitons will be found in the *Journal of the British Astronomical Association*, **34**, 214-5. (April 1924).

| Date | | The Star's Name | Mag. | Immersion Central Time h m | Immersion P ° | Immersion V | Emersion Central Time h m | Emersion P ° | Emersion V |
|---|---|---|---|---|---|---|---|---|---|
| | | | | EVANSTON, ILL. | | | | | |
| Dec. | 29 | 42 Aquarii | 5.5 | 5 22 | 47 | | 6 29 | 264 | |
| Jan. | 3 | $\xi^2$ Ceti | 4.3 | 17 13 | 96 | | 18 28 | 214 | |
| | 12 | 227 B Cancri | 6.4 | 3 59 | 76 | | 5 2 | 326 | |
| | 22 | 16 Sagitarii | 5.9 | Below Horizon | | | 5 31 | 330 | |
| | 22 | 15 Sagittarii | 5.3 | Below Horizon | | | 5 47 | 254 | |
| | 26 | 70 Aquarii | 6.1 | 17 47 | 74 | | 18 50 | 239 | |
| | 29 | 117 G Piscium | 6.5 | 19 40 | 54 | | 20 50 | 260 | |
| Feb. | 2 | Aldebaran | 1.1 | 15 39 | 101 | | 16 44 | 230 | |
| | 3 | 119 Tauri | 4.9 | 20 19 | 134 | | 21 14 | 207 | |
| | 8 | $\psi$ Leonis | 5.6 | 19 15 | 121 | | 20 19 | 260 | |
| | 15 | 13 Librae | 5.7 | 2 34 | 138 | | 3 44 | 272 | |
| | | | | NORTHFIELD, MINN. | | | | | |
| Dec. | 29 | 42 Aquarii | 5.5 | 5 19 | 34 | | 6 21 | 279 | |
| Jan. | 3 | $\xi^2$ Ceti | 4.3 | 17 7 | 80 | | 18 24 | 226 | |
| | 5 | 179 B Tauri | 5.9 | 20 3 | 145 | | 20 25 | 174 | |
| | 10 | *g* Geminorum | 5.0 | 7 0 | 154 | | 7 34 | 227 | |
| | 12 | 227 B Cancri | 6.4 | 3 50 | 81 | | 4 57 | 321 | |
| | 26 | 70 Aquarii | 6.1 | 17 44 | 62 | | 18 47 | 249 | |
| | 29 | 117 G Piscium | 6.5 | 19 35 | 41 | | 20 42 | 269 | |
| Feb. | 2 | Aldebaran | 1.1 | 15 35 | 89 | | 16 43 | 234 | |
| | 3 | 119 Tauri | 4.9 | 20 01 | 121 | | 21 09 | 219 | |
| | 3 | 120 Tauri | 5.6 | 21 15 | 150 | | 21 49 | 195 | |
| | 8 | $\psi$ Leonis | 5.6 | 19 12 | 112 | | 20 16 | 269 | |
| | 15 | 13 Librae | 5.7 | 2 29 | 139 | | 3 35 | 271 | |
| | | | | IOWA CITY, IOWA | | | | | |
| Dec. | 29 | 42 Aquarii | 5.5 | 5 18 | 41 | | 6 27 | 270 | |
| Jan. | 3 | $\xi^2$ Ceti | 4.3 | 17 8 | 90 | | 18 20 | 216 | |
| | 12 | 227 B Cancri | 6.4 | 3 53 | | | 5 1 | | |
| | 22 | 15 Sagittarii | 5.3 | Below Horizon | | | 6 13 | 247 | |
| | 26 | 70 Aquarii | 6.1 | 17 46 | 70 | | 18 53 | 253 | |
| | 29 | 117 G Piscium | 6.5 | 19 35 | 53 | | 20 47 | 257 | |
| Feb. | 2 | Aldebaran | 1.1 | 15 33 | 98 | | 16 38 | 250 | |
| | 3 | 119 Tauri | 4.9 | 20 6 | 127 | | 21 9 | 211 | |
| | 8 | $\psi$ Leonis | 5.6 | 19 12 | 121 | | 20 14 | 258 | |
| | 15 | 13 Librae | 5.7 | 2 33 | 141 | | 3 36 | 263 | |
| | | | | OMAHA, NEBRASKA | | | | | |
| Dec. | 29 | 42 Aquarii | 5.5 | 5 10 | 40 | 25 | 6 16 | 275 | 247 |
| Jan. | 3 | $\xi^2$ Ceti | 4.3 | 17 8 | 112 | 154 | 18 15 | 215 | 246 |
| | 12 | 227 B Cancri | 6.4 | 3 45 | 86 | 53 | 4 58 | 317 | 272 |
| | 26 | 70 Aquarii | 6.1 | 17 40 | 67 | 328 | 18 47 | 243 | 200 |
| | 29 | 117 G Piscium | 6.5 | 19 30 | 52 | 342 | 20 43 | 261 | 217 |
| Feb. | 2 | Aldebaran | 1.1 | 15 29 | 104 | 146 | 16 34 | 230 | 280 |
| | 3 | 119 Tauri | 4.9 | 19 57 | 132 | 170 | 20 54 | 206 | 208 |
| | 8 | $\psi$ Leonis | 5.6 | 19 13 | 120 | 171 | 20 8 | 260 | 291 |
| | 15 | 13 Librae | 5.7 | 2 27 | 146 | 187 | 3 34 | 264 | 288 |
| | 19 | 36 Sagittarii | 5.1 | 6 22 | 46 | 79 | 7 9 | 322 | 348 |
| | 19 | $\xi$ Sagittarii | 3.7 | 6 39 | 151 | 183 | 7 17 | 216 | 241 |

MOON'S PHASES. CENTRAL TIME.

| New | First Quarter | Full | Last Quarter |
|---|---|---|---|
| d h | d h | d h | d h |
| Jan. 24 9 | Jan. 1 17 | Jan. 9 21 | Jan. 17 18 |
| Feb. 22 20 | Jan. 31 11 | Feb. 8 16 | Feb. 16 4 |

an occultation is worth more than twice as much as an observation of one phase only.

The predictions given have been made by the following people: Mr. J. E. G. Yalden, for New York City; Miss V. M. Gushee, for Dearborn Observatory, Evanston, Ill.; Dr. C. H. Gingrich, for Goodsell Observatory, Northfield, Minn.; Miss Lucy Driscoll, for Iowa City, Iowa; and Rev. W. F. Rigge, for Omaha, Nebraska. Those for Washington have been taken from the *A. E.* For four stations only the occultations occurring before January 10 are given; further predictions for these stations will appear in the next number of POPULAR ASTRONOMY. Astronomical time is used throughout, i. e. on and after 1925 January 1 the astronomical day begins at midnight, instead of at noon as at present. P is the position angle measured from the north in the direction N E S W, and V is the position angle from the vertex, measured in the same direction. Maps for the daylight occultation of Aldebaran on February 2 will appear in POPULAR ASTRONOMY, or may be found in the above mentioned book by Rigge. Observations of the occultations occurring on January 22 and 26 *are especially desirable.*

Dearborn Observatory, Evanston, Ill., 1924 November 16.

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## THE NORTHERN CROSS.

When Winter comes and bleak December's snow
  Embalms the fragrant flowers of summertime,
The Northern Cross still lingers, loath to go,
  And decks the jeweled firmament sublime.

On Christmas eve, when all the world is gay
  And peace on earth makes human hearts beat high,
When sunset glow departs at close of day,
  The Cross stands upright in the western sky.

This symbol of our faith, for ages past
  Has marked the dying year on land and sea;
And may it shine resplendent when, at last,
  The sable night descends for you and me.

Washington, Pennsylvania. —WILLIAM H. MCENRUE.

## PLANET NOTES FOR JANUARY.

The *Sun* will move eastward from the constellation Sagittarius into the constellation Capricornus during January. It will move northward from —23° 4′ to —17° 35′.

THE CONSTELLATIONS AT 9:00 P. M. JANUARY 1.

The phases of the *moon* will occur as follows:

| | | | | |
|---|---|---|---|---|
| First Quarter | Jan. | 1 at | 5 P.M. | C.S.T. |
| Full Moon | | 9 " | 9 P.M. | " |
| Last Quarter | | 17 " | 6 P.M. | " |
| New Moon | | 24 " | 9 A.M. | " |
| First Quarter | | 31 " | 11 A.M. | " |

*Mercury* will be in a position of greatest elongation west of the sun on January 17. At this time it will be a very little south and about one and a

half hours east of the sun. It will be visible for a few mornings near this date in the southeastern sky (for northern observers) just before sunrise. On January 17 Mercury will be very near the fourth magnitude star $\mu$ Sagittarii.

*Venus* will continue its motion eastward a little faster than the sun. At the beginning of the month it will be about two hours west of the sun and at the end a little less than an hour and a half. It will therefore still be a morning star during January, but will be rather near the horizon at sunrise.

The *earth* will be in perihelion, that is nearest the sun for the year, on January 3.

*Mars* will still be visible in the evening sky. It will cross the meridian between five and six o'clock in the evening. At the end of the month it will be about 140,000,000 miles from the earth, and will be about as bright as Aldebaran.

*Jupiter* will rise a half hour before the sun at the beginning and two hours before the sun at the end of the month. It will not be far enough from the sun in the sky to be studied during this month.

*Saturn* will be in favorable position for observation in the morning. It will be on the meridian soon after sunrise during the month.

*Uranus* will cross the meridian about the middle of the afternoon during January. It will move from the constellation Aquarius into Pisces during the month.

*Neptune* will be near the meridian at midnight during January. It will therefore be above the horizon practically all night throughout the month. It will be 14° north of the equator.

## Occultations Visible at Washington.

[*From the American Ephemeris*]

| Date 1925 | Star's Name | Magnitude | IMMERSION. Washington C.T. | IMMERSION. Angle from N | EMERSION. Washington C.T. | EMERSION. Angle from N | Duration |
|---|---|---|---|---|---|---|---|
| | | | h m | ° | h m | ° | h m |
| Jan. 3 | $\xi^2$ Ceti | 4.3 | 18 33 | 123 | 19 15 | 180 | 0 42 |
| 12 | 227 B. Cancri | 6.4 | 5 15 | 67 | 6 6 | 334 | 0 51 |
| 22 | 15 Sagittarii | 5.3 | 5 44 | 122 | 6 43 | 258 | 0 59 |
| 22 | 16 Sagittarii | 5.9 | 5 50 | 44 | 6 25 | 337 | 0 35 |
| 26 | 70 Aquarii | 6.1 | 18 52 | 96 | 19 43 | 219 | 0 51 |
| 29 | 117 G. Piscium | 6.5 | 20 44 | 72 | 21 51 | 245 | 1 6 |

NOTE: Beginning with this month the time is given in Washington Civil Time instead of in Washington Mean Time; that is, the hours are counted from midnight to midnight instead of from noon to noon.

**Occultation of Aldebaran.** — The occultation of Aldebaran ($\alpha$ Tauri) on November 12 was observed through haze and clouds at Northfield. The times obtained for the immersion agree fairly well but those for the emersion are very uncertain. Most of the student observers with small telescopes and field glasses got the immersion too early and failed to see the emersion at all. The only observations worth recording are those by Professor Gingrich, who obtained

| | G. M. T. h m s | Instrument |
|---|---|---|
| Immersion | 14 35 00.5 | 16-inch Telescope |
| Emersion | 15 19 46.2 | 5-inch Finder |

Dr. Gingrich was uncertain whether the reappearance was due to the actual emersion or to a rift in the passing clouds.

## VARIABLE STARS.

### Minima of Variable Stars of Short Period.

[Calculated by members of the classes in Astronomy at Carleton College.]

Given to the nearest hour in Greenwich civil time; to obtain Eastern Standard time subtract $5^h$; Central Standard time $6^h$, etc.

| Star | R.A. 1900 | Decl. 1900 | Magnitude | Approx. Period | Greenwich civil times of minima in 1925 January | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | h m | ° ′ | | d h | d h | d h | d h | d h | d h | d h | d h | d h |
| SY Androm. | 0 08.0 | +43 09 | 9.5—13.0 | 34 21.8 | | | | | | | | |
| RT Sculptor. | 31.5 | —26 13 | 9.6—10.5 | 0 12.3 | 6 15 | 14 7 | 21 23 | 29 16 | | | | |
| U Cephei | 0 52.4 | +81 20 | 7.0— 9.0 | 1 11.8 | 3 10 | 10 22 | 18 9 | 25 21 | | | | |
| Z Persei | 2 33.7 | +41 46 | 9.4—12 | 3 01.4 | 1 12 | 7 15 | 19 21 | 25 23 | | | | |
| TW Cassiop. | 37.6 | +65 19 | 8.2— 9.0 | 1 10.3 | 5 6 | 13 20 | 22 10 | 31 0 | | | | |
| RY Persei | 39.0 | +47 43 | 8.0—10.3 | 6 20.7 | 7 23 | 14 20 | 21 17 | 28 14 | | | | |
| RZ Cassiop. | 39.9 | +69 13 | 6.9— 8.1 | 1 04.7 | 5 22 | 13 2 | 20 6 | 27 10 | | | | |
| TX Cassiop. | 44.4 | +62 22 | 9.4—10.1 | 2 22.2 | 6 19 | 15 14 | 24 8 | | | | | |
| ST Persei | 53.7 | +38 47 | 8.5—10.5 | 2 15.6 | 1 23 | 9 22 | 17 21 | 25 20 | | | | |
| RX Cassiop. | 2 58 8 | +67 11 | 8.6— 9.1 | 32 07.6 | | | 17 14 | | | | | |
| Algol | 3 01.7 | +40 34 | 2.3— 3.5 | 2 20.8 | 6 4 | 14 18 | 23 9 | | | | | |
| RT Persei | 16.7 | +46 12 | 9.5—11.5 | 0 20.4 | 3 15 | 10 10 | 24 1 | 30 20 | | | | |
| λ Tauri | 55.1 | +12 12 | 3.3— 4.2 | 3 22.9 | 4 20 | 12 18 | 20 15 | 28 13 | | | | |
| RW Tauri | 3 57.8 | +27 51 | 7.1— [11 | 2 18.5 | 3 10 | 11 17 | 20 0 | 28 8 | | | | |
| RV Persei | 4 04.2 | +33 59 | 9.5—11.0 | 1 23.4 | 4 19 | 12 17 | 20 15 | 28 12 | | | | |
| RW Persei | 13.3 | +42 04 | 8.8—11.0 | 13 04.8 | | 12 1 | | 25 6 | | | | |
| SZ Tauri | 31.4 | +18 20 | 7.2— 7.7 | 3 03.6 | 4 15 | 10 22 | 23 12 | 29 19 | | | | |
| RS Cephei | 4 48.6 | +80 06 | 9.5—12.0 | 12 10.1 | | 7 12 | 19 22 | | | | | |
| TT Aurigae | 5 02.8 | +39 27 | 7.8— 8.7 | 0 16.0 | 2 9 | 9 1 | 22 9 | 29 1 | | | | |
| RY Aurigae | 11.5 | +38 13 | 10.7—11.7 | 2 17.5 | 7 23 | 16 3 | 24 7 | | | | | |
| RZ Aurigae | 42.9 | +31 40 | 10.6—13.3 | 3 00.3 | 4 9 | 10 10 | 22 11 | 28 11 | | | | |
| SV Tauri | 45.8 | +28 05 | 9.4—11.0 | 2 04.0 | 2 2 | 10 18 | 19 10 | 28 2 | | | | |
| Z Orionis | 50.2 | +13 40 | 9.7—10.7 | 5 04.9 | 9 19 | 20 5 | 30 15 | | | | | |
| SV Gemin. | 54.6 | +24 28 | 9.8— [11 | 4 00.2 | 8 6 | 16 6 | 24 7 | | | | | |
| RW Gemin. | 5 55.4 | +23 08 | 9.5—11.0 | 2 20.8 | 3 13 | 9 6 | 20 17 | 26 11 | | | | |
| U Columbæ | 6 11.2 | —33 03 | 9.2—10.0 | 2 19.2 | 1 7 | 12 12 | 18 3 | 29 7 | | | | |
| SX Gemin. | 22.0 | +20 37 | 10.8—11.5 | 1 08 8 | 4 0 | 12 5 | 20 9 | 28 14 | | | | |
| RW Monoc. | 29.3 | + 8 54 | 9.0—10.8 | 1 21.7 | 3 6 | 10 22 | 18 12 | 26 4 | | | | |
| RX Gemin. | 43.6 | +33 21 | 8.8— 9.6 | 12 05.0 | 9 7 | | 21 12 | | | | | |
| RU Monoc. | 6 49.4 | — 7 28 | 9.8—10.5 | 0 21.5 | 3 6 | 10 11 | 24 19 | 31 23 | | | | |
| R Can. Maj. | 7 14.9 | —16 12 | 5.8— 6.4 | 1 03.3 | 4 9 | 11 4 | 24 19 | 31 15 | | | | |
| RY Gemin. | 21.7 | +15 52 | 8.9— [10 | 9 07.2 | 3 4 | 12 11 | 21 18 | 31 1 | | | | |
| Y Camelop. | 27.6 | +76 17 | 9.5—12 | 3 07.3 | 3 8 | 9 23 | 23 4 | 29 19 | | | | |
| TX Gemin. | 30.3 | +17 08 | 10.0—11.9 | 2 19.2 | 7 5 | 15 14 | 24 0 | | | | | |
| RR Puppis | 43.5 | —41 08 | 9.4—10.7 | 6 10.3 | 8 4 | 14 10 | 21 0 | 27 10 | | | | |
| V Puppis | 7 55.4 | —48 58 | 4.1— 4.8 | 1 10.9 | | 12 2 | 19 8 | 26 15 | | | | |
| X Carinae | 8 29.1 | —58 53 | 7.9— 8.7 | 0 13.0 | 5 8 | 13 11 | 21 14 | 29 17 | | | | |
| S Cancri | 8 38.2 | +19 24 | 8.2—10 | 9 11.6 | 1 23 | 11 11 | 20 23 | 30 10 | | | | |
| RX Hydrae | 9 00 8 | — 7 52 | 9.1—10.5 | 2 06 8 | 8 18 | 15 15 | 22 11 | 29 7 | | | | |
| S Velorum | 29.4 | —44 46 | 7.8— 9.3 | 5 22.4 | 8 8 | 14 7 | 20 5 | 26 4 | | | | |
| Y Leonis | 9 31.1 | +26 41 | 9.3—11.2 | 1 16.5 | 7 14 | 14 8 | 21 1 | 27 19 | | | | |
| RR Velorum | 10 17.8 | —41 36 | 10.0—10.9 | 1 20.5 | 4 21 | 12 7 | 19 17 | 27 3 | | | | |
| SS Carinæ | 10 54.2 | —61 23 | 12.2—12.8 | 3 07.2 | 4 17 | 11 7 | 24 12 | 31 3 | | | | |
| ST Urs. Maj. | 11 22.4 | +45 44 | 6.7— 7.2 | 8 19.2 | | 9 16 | 18 12 | 27 7 | | | | |
| RW Urs. Maj. | 35.4 | +52 34 | 10.3—11.4 | 7 07.9 | 3 10 | 10 18 | 18 2 | 25 10 | | | | |
| Z Draconis | 1 39.8 | +72 49 | 9.9—13.6 | 1 08.6 | 7 3 | 13 22 | 20 17 | 27 12 | | | | |
| RZ Centauri | 12 55.6 | —64 05 | 8.5— 8.9 | 1 21.0 | 5 8 | 12 20 | 20 8 | 27 20 | | | | |
| RS Can. Ven | 13 06.3 | +36 28 | 7.5—12.5 | 4 19.1 | 4 15 | 14 5 | 23 19 | | | | | |
| SS Centauri | 07.2 | —63 37 | 8.8—10.4 | 2 11.5 | 5 18 | 13 4 | 20 15 | 28 1 | | | | |
| SX Hydræ | 13 39.0 | —26 23 | 8.6—12.7 | 2 21.5 | 4 21 | 10 16 | 22 6 | 28 1 | | | | |

**Minima of Variable Stars of Short Period—Continued.**

| Star | R.A. 1900 | Decl. 1900 | Magnitude | Approx. Period | Greenwich civil times of minima in 1925 January | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | h m | ° ′ | | d h | d h | d h | d h | d h | d h | d h |
| δ Libræ | 14 55.6 | — 8 07 | 4.8— 6.2 | 2 07.9 | 7 11 | 14 10 | 21 10 | 28 9 | | |
| U Coronæ | 15 14.1 | +32 01 | 7.6— 8.7 | 3 10.9 | | 12 20 | 19 18 | 26 15 | | |
| TW Draconis | 15 32.4 | +64 14 | 7.3— 8.9 | 2 19.4 | 4 3 | 12 13 | 20 23 | 29 9 | | |
| SS Libræ | 15 43.4 | —15 14 | 9.3—11.5 | 0 18.4 | 4 22 | 12 2 | 19 7 | 26 11 | | |
| SW Ophiuchi | 16 11.1 | — 6 44 | 9.2—10.0 | 2 10.7 | 7 23 | 15 7 | 22 16 | 30 0 | | |
| SX Ophiuchi | 12.6 | — 6 25 | 10.5—11.2 | 2 01.5 | 5 10 | 13 16 | 21 22 | 30 4 | | |
| R Aræ | 31.1 | —56 48 | 6.8— 7.9 | 4 10.2 | 8 5 | 17 1 | 25 22 | | | |
| TT Herculis | 16 49.9 | +17 00 | 8.9— 9.3 | 20 18.1 | | | 21 14 | | | |
| TU Herculis | 17 09.8 | +30 50 | 9.5—12 | 2 06.4 | 4 4 | 10 23 | 24 13 | 31 9 | | |
| U Ophiuchi | 11.5 | + 1 19 | 6.0— 6.7 | 0 20.1 | 8 14 | 16 23 | 25 9 | | | |
| *u* Herculis | 13.6 | +33 12 | 4.6— 5.4 | 2 01.2 | 9 13 | 15 16 | 21 20 | 28 0 | | |
| TX Herculis | 15.4 | +42 00 | 8.3— 9.0 | 1 00.7 | 5 10 | 11 17 | 24 1 | 30 5 | | |
| RV Ophiuchi | 29.8 | + 7 19 | 9. —12 | 3 16.5 | 9 3 | 16 12 | 23 21 | 31 6 | | |
| SZ Herculis | 36.0 | +33 01 | 9.5—10.3 | 0 19.6 | 6 23 | 15 4 | 23 8 | 31 12 | | |
| TX Scorpii | 48.6 | —34 13 | 7.5— 8.2 | 0 22.6 | 6 1 | 13 14 | 21 3 | 28 16 | | |
| UX Herculis | 49.7 | +16 57 | 8.8—10.5 | 1 13.2 | 6 23 | 14 17 | 22 11 | 30 5 | | |
| Z Herculis | 53.6 | +15 09 | 7.1— 7.9 | 3 23.8 | 7 20 | 15 20 | 23 19 | 31 19 | | |
| WX Sagittarii | 53.6 | —17 24 | 9.2—10.8 | 2 03.1 | 4 1 | 12 13 | 21 2 | 29 14 | | |
| WY Sagittarii | 17 54.9 | —23 01 | 9.5—10.6 | 4 16.0 | 1 17 | 11 1 | 15 7 | 25 1 | | |
| SX Draconis | 18 03.0 | +58 23 | 9.3—10.5 | 5 04.1 | 2 0 | 12 8 | 17 12 | 27 21 | | |
| RS Sagittarii | 11.0 | —34 08 | 5.9— 6.3 | 2 10.0 | 1 12 | 8 18 | 23 6 | 30 12 | | |
| V Serpentis | 11.1 | —15 34 | 9.5—11.1 | 3 10.9 | 4 12 | 11 10 | 18 8 | 25 6 | | |
| RZ Scuti | 21.1 | — 9 15 | 7.4— 8.3 | 15 03.2 | | 13 9 | | 28 12 | | |
| RZ Draconis | 21.8 | +58 50 | 9.5—10.2 | 0 13.2 | 7 4 | 14 8 | 21 11 | 28 15 | | |
| RX Herculis | 26.0 | +12 32 | 7.0— 7.6 | 0 21.3 | 4 8 | 11 10 | 18 13 | 25 16 | | |
| SX Sagittarii | 39.7 | —30 36 | 8.7— 9.8 | 2 01.8 | | 8 18 | 17 1 | 25 9 | | |
| RR Draconis | 40.8 | +62 34 | 9.3—13 | 2 19.9 | 2 2 | 10 13 | 18 1 | 27 13 | | |
| RS Scuti | 43.7 | —10 21 | 9.3—10.3 | 0 15.9 | 3 13 | 10 5 | 23 11 | 30 3 | | |
| β Lyræ | 46.4 | +33 15 | 3.4— 4.1 | 12 21.8 | | 10 21 | | 23 19 | | |
| U Scuti | 18 48.9 | —12 44 | 9.1— 9.6 | 0 22.9 | 6 3 | 13 19 | 21 10 | 29 2 | | |
| RX Draconis | 19 01.1 | +58 35 | 9.3—10.2 | 1 21.4 | 4 13 | 12 2 | 19 16 | 27 6 | | |
| RV Lyræ | 12.5 | +32 15 | 11. —12.8 | 3 14.4 | 8 16 | 15 20 | 23 1 | 30 6 | | |
| RS Vulpec. | 13.4 | +22 16 | 6.9— 8.0 | 4 11.4 | 2 10 | 11 9 | 20 8 | 29 7 | | |
| U Sagittæ | 14.4 | +19 26 | 6.5— 9.0 | 3 09.1 | 8 4 | 14 23 | 21 17 | 28 11 | | |
| Z Vulpec. | 17.5 | +25 23 | 7.3— 8.5 | 2 10.9 | 9 10 | 16 19 | 24 3 | 31 12 | | |
| TT Lyræ | 24.3 | +41 30 | 9.4—11.6 | 5 05.8 | 3 1 | 13 12 | 18 18 | 29 6 | | |
| UZ Draconis | 26.1 | +68 44 | 9.0— 9.8 | 1 15.1 | 2 15 | 9 4 | 22 5 | 28 17 | | |
| SY Cygni | 19 42.7 | +32 28 | 10. —12 | 6 00.2 | 6 23 | 12 23 | 24 23 | 30 23 | | |
| WW Cygni | 20 00.6 | +41 18 | 9.3—13.4 | 3 07.6 | 7 0 | 13 16 | 20 7 | 26 22 | | |
| SW Cygni | 03.8 | +46 01 | 9. —11.7 | 4 13.8 | 1 17 | 10 20 | 20 0 | 29 3 | | |
| VW Cygni | 11.4 | +34 12 | 9.8—11.8 | 8 10.3 | 4 15 | 13 1 | 21 11 | 29 22 | | |
| RW Capric. | 12.2 | —17 59 | 8.8—10.6 | 3 09.4 | 4 13 | 11 8 | 24 22 | 31 17 | | |
| UW Cygni | 19.6 | +42 55 | 10.5—13 | 3 10.8 | 4 21 | 11 18 | 18 16 | 25 13 | | |
| V Vulpec | 32.3 | +26 15 | 8.2— 9.8 | 37 19.0 | 7 20 | | | | | |
| W Delphini | 33.1 | +17 56 | 9.4—12.1 | 4 19.4 | 1 20 | 11 11 | 21 2 | 30 16 | | |
| RR Delphini | 38.9 | +13 35 | 10.5—11.8 | 4 14.4 | 7 17 | 16 22 | 26 3 | | | |
| Y Cygni | 48.1 | +34 17 | 7.1— 7.9 | 1 12.0 | 8 20 | 17 20 | 26 20 | | | |
| WZ Cygni | 49.3 | +38 27 | 9.9—10.8 | 0 14.0 | 5 23 | 13 14 | 21 4 | 28 18 | | |
| RR Vulpec | 20 50.5 | +27 32 | 9.6—11.0 | 5 01.2 | | 11 13 | 21 15 | 31 18 | | |
| RY Aquarii | 21 14.8 | —11 14 | 8.8—10.4 | 1 23.2 | 4 2 | 11 23 | 19 20 | 27 17 | | |
| UZ Cygni | 55.2 | +43 52 | 8.9—11.6 | 31 07.3 | | 13 19 | | | | |
| RT Lacertæ | 21 57.4 | +43 24 | 9.1—10.5 | 5 01.7 | 1 15 | 11 19 | 21 22 | | | |
| RW Lacertæ | 22 40.6 | +49 08 | 10.2—11.2 | 5 04.4 | 2 21 | 13 6 | 18 10 | 28 19 | | |
| VW Pegasi | 51.7 | +32 42 | 10.0—10.6 | 5 06.4 | 2 8 | 12 21 | 18 3 | 28 16 | | |
| Y Piscium | 23 29.3 | + 7 22 | 9.0—12.0 | 3 18.4 | 8 1 | 15 14 | 23 3 | 30 16 | | |
| TW Androm. | 23 58.2 | +32 17 | 8.6—11.5 | 4 02.9 | 7 9 | 15 15 | 23 21 | | | |

## Maxima of Variable Stars of Short Period.

[Calculated by members of the classes in Astronomy at Carleton College.]

Given to the nearest hour in Greenwich civil time; to obtain Eastern Standard time subtract $5^h$; Central Standard time $6^h$, etc.

| Star | R.A. 1900 | Decl. 1900 | Magnitude | Approx. Period | Greenwich civil times of maxima in 1925 January | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | h m | ° ′ | | d h | d h | d h | d h | d h | d h | d h | d h | d h |
| SX Cassiop. | 0 05.5 | +54 20 | 8.6— 9.2 | 36 13.7 | | | 14 23 | | | | | |
| SY Cassiop. | 0 09.8 | +57 52 | 9.3— 9.9 | 4 01.7 | 6 0 | | 14 3 | | 22 7 | | 30 10 | |
| RR Ceti | 1 27.0 | + 0 50 | 8.3— 9.0 | 0 13.3 | 8 6 | | 16 0 | | 23 18 | | 31 12 | |
| RW Cassiop. | 1 30.7 | +57 15 | 8.9—11.0 | 14 19.2 | 2 4 | | 16 0 | | | | 30 20 | |
| V Arietis | 2 09.6 | +11 46 | 8.3— 9.0 | 0 23.8 | 6 1 | | 13 23 | | 21 21 | | 29 19 | |
| SU Cassiop. | 2 43.0 | +68 28 | 6.5— 7.0 | 1 22.8 | 6 15 | | 14 10 | | 22 5 | | 30 1 | |
| RW Camelop. | 3 46.2 | +58 21 | 8.2— 9.4 | 16 00.0 | 5 6 | | | | 21 16 | | | |
| SX Persei | 4 10.2 | +41 27 | 10.4—11.2 | 4 07.0 | 9 23 | | 18 13 | | 27 3 | | | |
| SV Persei | 42.8 | +42 07 | 8.8— 9.6 | 11 03.1 | 1 8 | | 12 11 | | | | 23 14 | |
| RX Aurigæ | 4 54.5 | +39 49 | 7.2— 8.1 | 11 15.0 | 1 11 | | 13 2 | | 24 17 | | | |
| SX Aurigæ | 5 04.6 | +42 02 | 8.0— 8.7 | 1 12.8 | 6 12 | | 14 4 | | 21 20 | | 29 12 | |
| SY Aurigæ | 05.5 | +42 41 | 8.4— 9.5 | 10 03.3 | 8 12 | | 18 16 | | 28 19 | | | |
| Y Aurigæ | 21.5 | +42 21 | 8.6— 9.6 | 3 20.6 | 7 19 | | 15 13 | | 23 6 | | 30 23 | |
| RZ Gemin. | 5 56.6 | +22 15 | 9.1—10.0 | 5 12.7 | 1 21 | | 12 23 | | 18 12 | | 29 13 | |
| RS Orionis | 6 16.5 | +14 44 | 8.2— 8.9 | 7 13.6 | 3 8 | | 10 22 | | 18 11 | | 26 0 | |
| T Monoc. | 19.8 | + 7 08 | 5.7— 6.8 | 27 00.3 | | | 15 2 | | | | | |
| RT Aurigæ | 23.0 | +30 33 | 5.1— 6.0 | 3 17.5 | 1 21 | | 9 8 | | 16 19 | | 24 6 | |
| W Gemin. | 29.2 | +15 24 | 6.7— 7.5 | 7 22.0 | 8 7 | | 16 5 | | 24 0 | | | |
| ζ Gemin. | 6 58.2 | +20 43 | 3.7— 4.3 | 10 03.7 | 2 14 | | 12 18 | | 22 21 | | | |
| RU Camelop | 7 10.9 | +69 51 | 8.5— 9.8 | 22 06.5 | | | | | 16 21 | | | |
| RR Gemin. | 7 15.2 | +31 04 | 10.0—11.5 | 0 09.5 | 6 17 | | 14 16 | | 22 15 | | 30 14 | |
| V Carinae | 8 26.7 | —59 47 | 7.4— 8.1 | 6 16.7 | 1 17 | | 8 9 | | 21 19 | | 28 12 | |
| T Velorum | 8 34.4 | —47 01 | 7.6— 8.5 | 4 15.3 | 2 5 | | 11 12 | | 20 19 | | 30 1 | |
| V Velorum | 9 19.2 | —55 32 | 7.5— 8.2 | 4 08.9 | 6 8 | | 15 2 | | 23 19 | | | |
| Z Leonis | 9 46.4 | +27 22 | 7.9— 9.6 | 56 08.7 | | | | | | | | |
| RR Leonis | 10 02.1 | +24 29 | 9.1—10.1 | 0 10.9 | 3 23 | | 10 18 | | 24 7 | | 31 2 | |
| SU Draconis | 11 32.2 | +67 53 | 8.9— 9.6 | 0 15.8 | 2 12 | | 9 3 | | 22 8 | | 28 22 | |
| S Muscae | 12 07.4 | —69 36 | 6.4— 7.3 | 9 15.8 | 4 11 | | 14 3 | | 23 18 | | | |
| SW Draconis | 12.8 | +70 04 | 8.8— 9.6 | 0 13.7 | 5 5 | | 13 5 | | 21 4 | | 29 4 | |
| T Crucis | 15.9 | —61 44 | 6.8— 7.6 | 6 17.6 | 6 16 | | 13 10 | | 20 3 | | 26 21 | |
| R Crucis | 18.1 | —61 04 | 6.8— 7.9 | 5 19.8 | 4 8 | | 10 4 | | 21 20 | | 27 15 | |
| S Crucis | 12 48.4 | —57 53 | 6.5— 7.6 | 4 16.6 | 7 16 | | 17 1 | | 21 17 | | 31 3 | |
| W Virginis | 13 20.9 | — 2 52 | 8.7—10.4 | 17 06.5 | | | 8 12 | | 25 18 | | | |
| SS Hydræ | 25.0 | —23 08 | 7.4— 8.1 | 8 04.8 | 1 13 | | 9 17 | | 17 22 | | 26 3 | |
| RV Urs. Maj. | 13 29.4 | +54 31 | 9.2— 9.9 | 0 11.2 | 8 16 | | 15 16 | | 22 17 | | 29 17 | |
| ST Virginis | 14 22.5 | — 0 27 | 10.3—11.4 | 0 09.9 | 1 21 | | 9 7 | | 16 17 | | 24 3 | |
| V Centauri | 25.4 | —56 27 | 6.4— 7.8 | 5 11.9 | 5 23 | | 11 11 | | 22 10 | | 27 22 | |
| RS Bootis | 29.3 | +32 11 | 8.9—10.0 | 0 09.1 | 2 11 | | 10 0 | | 17 13 | | 24 2 | |
| R Triang.Austr. | 15 10.8 | —66 08 | 6.7— 7.4 | 3 09.3 | 1 21 | | 8 16 | | 22 6 | | 29 0 | |
| S Triang.Austr. | 15 52.2 | —63 29 | 6.4— 7.4 | 6 07.8 | 3 11 | | 9 19 | | 22 10 | | 28 18 | |
| S Normæ | 16 10.6 | —57 39 | 6.6— 7.6 | 9 18.1 | 7 7 | | 17 1 | | 26 19 | | | |
| RW Draconis | 33.7 | +58 03 | 9.6—10.8 | 0 10.6 | 7 4 | | 16 0 | | 24 21 | | | |
| RV Scorpii | 16 51.8 | —33 27 | 6.7— 7.4 | 6 01.5 | 5 5 | | 11 7 | | 23 10 | | 29 11 | |
| X Sagittarii | 17 41.3 | —27 48 | 4.4— 5.0 | 7 00.3 | 5 21 | | 12 21 | | 26 21 | | 30 21 | |
| Y Ophiuchi | 47.3 | — 6 07 | 6.1— 6.5 | 17 02.9 | 3 18 | | | | 20 21 | | | |
| W Sagittarii | 17 58.6 | —29 35 | 4.3— 5.1 | 7 14.3 | 1 20 | | 9 10 | | 17 0 | | 24 14 | |
| Y Sagittarii | 18 15.5 | —18 54 | 5.4— 6.2 | 5 18.6 | 1 12 | | 7 0 | | 18 20 | | 24 14 | |
| U Sagittarii | 26.0 | —19 12 | 6.5— 7.3 | 6 17.9 | 4 18 | | 11 12 | | 25 0 | | 31 18 | |
| Y Scuti | 32.6 | — 8 27 | 8.7— 9.2 | 10 08.3 | | | 9 19 | | 20 3 | | 30 12 | |
| RZ Lyræ | 39.9 | +32 42 | 9.9—11.2 | 0 12.3 | 5 13 | | 13 6 | | 20 22 | | 28 14 | |
| RT Scuti | 18 44.1 | —10 30 | 9.1— 9.7 | 0 11.9 | 2 2 | | 9 12 | | 24 9 | | 31 20 | |
| κ Pavonis | 18 46.6 | —67 22 | 3.8— 5.2 | 9 02.2 | 6 23 | | 16 1 | | 25 3 | | | |
| U Aquilæ | 19 24.0 | — 7 15 | 6.2— 6.9 | 7 00.6 | 4 8 | | 11 9 | | 18 10 | | 25 10 | |

**Maxima of Variable Stars of Short Period—Continued.**

| Star | R.A. 1900 | Decl. 1900 | Magnitude | Approx. Period | Greenwich civil times of maxima in 1925 January | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | h m | ° ′ | | d h | d h | d h | d h | d h | d h | d h |
| XZ Cygni | 19 30.4 | +56 10 | 8.6— 9.3 | 0 11.2 | 5 7 | 12 7 | 19 7 | 26 7 | | |
| U Vulpec. | 32.2 | +20 07 | 6.5— 7.6 | 7 23.5 | | 8 20 | 16 19 | 24 19 | | |
| SU Cygni | 40.8 | +29 01 | 6.2— 7.0 | 3 20.3 | 4 18 | 12 11 | 20 4 | 27 8 | | |
| η Aquilæ | 47.4 | + 0 45 | 3.7— 4.5 | 7 04.2 | 6 2 | 13 6 | 20 11 | 27 15 | | |
| S Sagittæ | 51.5 | +16 22 | 5.6— 6.4 | 8 09.2 | 3 11 | 11 25 | 20 5 | 28 14 | | |
| X Vulpec. | 19 53.3 | +26 17 | 9.5—10.5 | 6 07.7 | 5 9 | 11 17 | 24 8 | 30 16 | | |
| X Cygni | 20 39.5 | +35 14 | 6.0— 7.0 | 16 09.3 | | 16 23 | | | | |
| T Vulpec. | 47.2 | +27 52 | 5.5— 6.1 | 4 10.5 | 3 3 | 12 0 | 20 21 | 29 18 | | |
| UY Cygni | 52.3 | +30 03 | 9.6—10.4 | 0 13.5 | 5 19 | 12 12 | 19 6 | 25 23 | | |
| RV Capric. | 55.9 | —15 37 | 9.2—10.1 | 0 10.7 | 4 20 | 11 13 | 18 7 | 25 0 | | |
| TX Cygni | 20 56.4 | +42 12 | 8.5— 9.7 | 14 17.4 | | 9 2 | | 23 18 | | |
| VY Cygni | 21 00.4 | +39 34 | 8.8— 9.5 | 7 20.6 | 8 23 | 16 20 | 24 17 | | | |
| SW Aquarii | 10.2 | — 0 20 | 9.9—10.8 | 0 11.0 | 2 12 | 9 9 | 23 4 | 30 1 | | |
| VZ Cygni | 21 47.7 | +42 40 | 8.2— 9.2 | 4 20.7 | 2 23 | 12 16 | 17 13 | 29 7 | | |
| Y Lacertæ | 22 05.2 | +50 33 | 9.1— 9.6 | 4 07.8 | 5 6 | 13 22 | 22 13 | 31 5 | | |
| δ Cephei | 25.5 | +57 54 | 3.7— 4.6 | 5 08.8 | 6 13 | 11 21 | 17 6 | 28 0 | | |
| Z Lacertæ | 36.9 | +56 18 | 8.2— 9.0 | 10 21.1 | | 10 3 | 21 0 | 31 21 | | |
| RR Lacertæ | 37.5 | +55 55 | 8.5— 9.2 | 6 10.1 | 3 1 | 9 11 | 22 7 | 28 16 | | |
| V Lacertæ | 44.5 | +55 48 | 8.5— 9.5 | 4 23.6 | 6 6 | 16 5 | 21 5 | 26 4 | | |
| X Lacertæ | 22 45.0 | +55 54 | 8.2— 8.6 | 5 10.7 | 4 15 | 15 12 | 20 22 | 31 20 | | |
| SW Cassiop. | 23 03.7 | +58 11 | 9.2— 9.7 | 5 10.6 | 1 18 | 12 15 | 18 1 | 28 23 | | |
| RS Cassiop. | 32.6 | +61 52 | 9.0—11.0 | 6 07.1 | 1 15 | 7 22 | 20 12 | 26 19 | | |
| RY Cassiop. | 47.2 | +58 11 | 9.3—11.8 | 12 03.4 | | 12 3 | | 24 7 | | |
| V Cephei | 23 51.7 | +82 38 | 6.0— 7.0 | 0 23.9 | 6 1 | 13 1 | 20 0 | 27 0 | | |

**Five New Variable Stars.**— On photographs made with the 16-inch Metcalf telescope, Miss Woods has found the following new variable stars:

| Harvard Variable | R.A.1900 h m s | Dec.1900 ° ′ | Galactic Long. ° | Galactic Lat. ° | Max. Magn. | Min. Magn. |
|---|---|---|---|---|---|---|
| 3775 | 2 2 7 | +27 27.6 | 112 | —32 | 11.2 | 14.8 |
| 3776 | 4 59 15 | +21 37.5 | 148 | —10 | 12.8 | 14.6 |
| 3777 | 17 33 9 | +50 28.5 | 44 | +32 | 11.0 | [15.0 |
| 3778 | 23 8 9 | —15 52.0 | 25 | —65 | 10.2 | 15.4 |
| 3779 | 23 55 10 | +26 3.1 | 78 | —35 | 12.6 | 14.2 |

The periods of H. V. 3775 and 3778 are long, the first probably about 210 days. A star of the fifteenth magnitude follows H. V. 3776 approximately 1ˢ2 and is 20″ north. H. V. 3779 is within a degree of Z Pegasi.

Harvard College Observatory Bulletin 807.
Cambridge, Massachusetts, September 30, 1924.

**Test of C.DM. −27°11944 for Variability.** — The spectrum of the ninth magnitude star C. DM. −27°11944 contains numerous bright lines of hydrogen, helium, and iron, according to Humason and Merrill (*Pub. A. S. P.*, **34**, 295, 1922). Spectroscopically it is probably intermediate between P Cygni and a typical nova near maximum. The star P Cygni (Nova Cygni No. 1) appears to be an example of one of the products of novae. For two and a half centuries its light has been constant, so far as we know; but its spectrum still retains characteristics that probably developed at the time of the first recorded outburst in 1600.

Since C. DM. −27°11944 may also have been a nova at some time in the past,

it has been examined for variability on fifty-one photographs made with the Bache telescope at Arequipa. Thirteen of the photographs were made between 1890 and 1900; twenty-three in the interval 1900 to 1910; fifteen in the interval 1910 to 1918. If variability now exists it probably does not exceed a tenth of a magnitude in range, as no variation is found on the Harvard photographs.

The star is on the border of the dense star cloud in Sagittarius (galactic longitude 328°, galactic latitude —1°),—a position that strengthens its similarity to novae.

Harvard College Observatory Bulletin 807.
Cambridge, Massachusetts, September 30, 1924.

## Monthly Report of the American Association of Variable Star Observers, July 20 to September 20, 1924.

Another serious break has been made in the observing ranks of the Association by the sudden death, on October 19, of one of our most ardent and enthusiastic observers, Mr. Charles Y. McAteer of Pittsburgh, Pa. A unique character in many respects, his passing will be keenly felt by all those with whom he ever came in contact. A diligent observer since 1912, he accumulated a total of more than 15,000 observations and hardly a report can be examined but that "M" will be found therein. The Association will soon publish a short biography of Mr. McAteer for distribution to all its members.

Professor Eaton, who has so faithfully carried on the arduous task of preparing these reports during the past few years, finds that he must relinquish the work for a few months at least. Until further notice, members will please address all communications, including H. C. O. and A. A. V. S. O. reports, to the A. A. V. S. O. at Harvard College Observatory, Cambridge, Mass.

The Assocaition held a most successful and enthusiastic meeting on October 11, at the Harvard Observatory. Nearly seventy-five members and their friends were present. Several papers were read and Professor Brown, of Yale University, gave us a very timely lecture concerning what the Association might do in connection with the coming total solar eclipse. Professor King, of Harvard Observatory, gave us an extremely informative lecture on "Telescopes, Ancient and Modern." The Council chose Mr. J. E. G. Yalden to be its new President, and Professor Eaton was chosen Vice President. Messrs. Jordan and Olcott were re-elected Treasurer and Secretary, respectively. Misses Young and Farnsworth and Messrs. Pickering and Campbell continue to serve on the Council.

The irregular variables, R Cor. Bor., SS Cygni, SU Tauri and RY Sagittarii, have all been in the lime-light during the past few months. Messrs. Baldwin, Peltier, Waterfield, Chandra and Mitchell deserve commendation for their splendid reports, and Mrs. Lytle and Mrs. Morris have maintained the standard on the part of our women members. Mr. Marks, of Nantucket, Mass., offers his first contribution herewith.

Through the generosity of our Patron, Mr. C. W. Elmer, the Association is enabled to fulfil a long desired ambition, by furnishing Mr. Chandra of Bagchar, India, with a splendid six-inch telescope. Mr. Chandra has made a wonderful record of achievement with his small three-inch outfit.

The next issue of "Variable Comments" will contain a complete account of the recent annual meeting.

—Leon Campbell.

VARIABLE STAR OBSERVATIONS, July 20 to September 20, 1924.

| Star | J.D. | Est.Obs. | J.D. | Est.Obs. |
|---|---|---|---|---|
| | July 0 = J. D. 2423967 | | Aug. 0 = J. D. 2423998 | |
| 001046 X ANDROMEDAE— | | | | |
| | 3994.6 | 11.3 M, | 4020.7 | 8.6 Wf, |
| | 3987.7 | 11.9 Wf, | 4025.8 | 8.6 Wf, |
| | 3991.7 | 11.6 Wf, | 4029.8 | 9.0 Br, |
| | 3995.7 | 10.8 Wf, | 4030.7 | 8.5 Wf, |
| | 4002.8 | 10.0 Wf, | 4036.7 | 8.7 Wf, |
| | 4007.9 | 10.0 Br, | 4039.7 | 8.9 Ie. |
| *001620* T CETI— | | | | |
| | 3814.3 | 6.5 An, | 4005.2 | 6.7 Kd, |
| | 3987.2 | 6.6 Kd, | 4021.3 | 6.4 Kd, |
| | 3997.5 | 6.4 An, | 4028.6 | 6.2 An. |
| | 4001.2 | 6.4 Kd, | | |
| 001726 T ANDROMEDAE— | | | | |
| | 4008.8 | 13.4 Ie, | 4027.7 | 13.0 Br. |
| | 4024.6 | 13.0 Ie, | | |
| 001755 T CASSIOPEIAE— | | | | |
| | 3983.7 | 8.8 Mi, | 4012.6 | 8.4 Ca, |
| | 3989.7 | 8.7 Mi, | 4017.4 | 8.5 L, |
| | 3990.7 | 8.3 Ca, | 4021.8 | 8.2 Pt, |
| | 3991.8 | 8.5 Sg, | 4024.6 | 8.7 Ca, |
| | 3993.8 | 8.2 Pt, | 4035.6 | 9.2 Du, |
| | 3999.8 | 9.6 M, | 4038.6 | 9.0 Mi, |
| | 4000.7 | 8.8 Mi, | 4039.7 | 8.7 Ie, |
| | 4005.6 | 8.1 Ca, | 4040.6 | 8.9 Ca. |
| | 4012.6 | 8.9 Mi, | | |
| 001838 R ANDROMEDAE— | | | | |
| | 3978.4 | 10.0 Ch, | 4007.9 | 11.0 Br, |
| | 3986.7 | 10.3 Cy, | 4016.8 | 11.0 M, |
| | 3993.8 | 10.7 Pt, | 4019.7 | 11.3 Ie, |
| | 4000.6 | 11.0 O, | 4021.8 | 11.5 Pt, |
| | 4000.8 | 11.0 Gb, | 4024.7 | 11.7 Cy. |
| | 4000.8 | 10.9 Ie, | 4025.7 | 11.4 Br, |
| | 4002.8 | 11.0 Gb, | 4026.2 | 11.7 Ch. |
| | 4004.7 | 11.1 Gb, | | |
| *001909* S CETI— | | | | |
| | 3786.8 | 8.8 M, | 4021.8 | 9.9 Pt, |
| | 3993.8 | 11.5 Mi, | 4026.7 | 9.4 Ie, |
| | 3993.8 | 11.3 Pt, | 4026.8 | 9.5 Mi, |
| | 3996.7 | 9.8 Ca, | 4028.2 | 8.9 Ch, |
| | 3999.8 | 11.2 Mi, | 4030.7 | 8.9 Ca, |
| | 4006.7 | 10.5 Ca, | 4032.9 | 8.7 Br. |
| 004047 U CASSIOPEIAE— | | | | |
| | 3987.7 | [14.0 Wf, | 4025.8 | 13.1 Wf, |
| | 3991.7 | 15.0 Wf, | 4025.7 | 13.5 Br, |
| | 3995.7 | 14.9 Wf, | 4030.7 | 12.8 Wf, |
| | 4002.8 | 14.9 Wf, | 4036.7 | 12.4 Wf, |
| | 4020.7 | 13.5 Wf, | 4039.8 | 12.3 Br. |
| | 4024.6 | 12.9 Ie, | | |
| 004435 V ANDROMEDAE— | | | | |
| | 3994.6 | 11.7 O, | 4027.7 | 12.8 Br. |
| | 4026.8 | 12.2 M, | | |
| 004533 RR ANDROMEDAE— | | | | |
| | 3987.8 | 11.6 Wf, | 4025.8 | 9.9 Wf, |
| | 3991.7 | 11.5 Wf, | 4029.8 | 9.4 Br, |
| | 3995.7 | 11.2 Wf, | 4030.7 | 9.6 Wf, |
| | 3996.6 | 11.2 O, | 4032.6 | 9.6 O, |
| | 4002 8 | 11.0 Wf, | 4036.7 | 9.4 Wf. |
| | 4020.7 | 10.3 Wf, | | |
| 004746a RV CASSIOPEIAE— | | | | |
| | 3990.7 | 14.7 Wf, | 4021.8 | 12.5 Pt, |
| | 3995.7 | 14.7 Wf, | 4025.8 | 11.4 Wf, |
| | 4002.8 | 14.6 Wf, | 4030.7 | 10.3 Wf, |
| | 4014.7 | [12.9 Br, | 4031.7 | 10.2 Br, |
| | 4020.7 | 12.1 Wf, | 4036.7 | 9.8 Wf. |
| 004958 W CASSIOPEIAE— | | | | |
| | 3993.6 | 9.6 O, | 4024.6 | 10.8 Cg, |
| | 3993.8 | 8.8 Pt, | 4027.8 | 9.5 M. |
| | 4021.8 | 8.9 Pt, | | |
| 010102 Z CETI— | | | | |
| | 3993.8 | 13.4 Pt, | 4032.8 | 12.4 Br. |
| | 4021.8 | 13.3 Pt, | | |
| 010940 U ANDROMEDAE— | | | | |
| | 3999.8 | 12.2 M, | 4029.8 | 13.2 Br. |
| | 4025.6 | 13.2 Ie, | | |
| 011041 UZ ANDROMEDAE— | | | | |
| | 3990.7 | 15.2 Wf, | 4020.7 | 14.7 Wf, |
| | 3991.8 | 15.2 Wf, | 4025.8 | 14.6 Wf, |
| | 3995.7 | 14.9 Wf, | 4029.8 | 14.7 Br, |
| | 4002.8 | 14.8 Wf, | 4030.7 | 14.4 Wf. |
| 011712 U PISCIUM— | | | | |
| | 3993.8 | 11.2 Pt, | 4030.0 | 11.2 Br, |
| | 4021.8 | 11.4 Pt, | 4039.8 | 12.0 Br. |
| | 4027.8 | 11.4 M, | | |
| 012350 RZ PERSEI— | | | | |
| | 4007.9 | 13.0 Br, | 4029.8 | 13.3 Br. |
| 012502 R PISCIUM— | | | | |
| | 3993.8 | 10.8 Pt, | 4030.0 | 12.3 Br, |
| | 4021.8 | 11.7 Pt, | 4032.8 | 11.4 M. |
| 013238 RU ANDROMEDAE— | | | | |
| | 3989.8 | 12.2 Wf, | 4024.6 | 11.0 Ie, |
| | 3995.7 | 11.8 Wf, | 4028 2 | 11.7 Ch, |
| | 4002.8 | 11.5 Wf, | 4029.9 | 11.1 Br, |
| | 4007.9 | 11.4 Br, | 4030.7 | 10.9 Wf, |
| | 4020.7 | 11.3 Wf, | 4036.7 | 10.8 Wf. |
| | 4021.8 | 11.1 Pt, | | |
| 013338 Y ANDROMEDAE— | | | | |
| | 4028.2 | 12.0 Ch, | 4029.9 | 13.8 Br. |
| 014958 X CASSIOPEIAE— | | | | |
| | 3993.8 | 10.2 Pt, | 4021.8 | 9.5 Pt, |
| | 3999.8 | 11.0 M, | 4024.8 | 10.8 M. |
| 015354 U PERSEI— | | | | |
| | 3993.7 | 8.8 Mi, | 4021.8 | 8.8 Pt, |
| | 3993.8 | 8.6 Pt, | 4024.8 | 9.0 M, |
| | 3999.8 | 9.1 M, | 4025.7 | 8.7 Mi, |
| | 4000.7 | 8.8 Mi, | 4034.7 | 8.5 Mi, |
| | 4000.7 | 8.8 Kl, | 4037.7 | 8.4 Kl, |
| | 4000.7 | 8.7 Ca, | 4043.5 | 8.3 Ca. |
| | 4011.7 | 8.7 Mi, | | |
| 021024 R ARIETIS— | | | | |
| | 3986.7 | 10.4 Cy, | 4021.8 | 13.0 Pt, |
| | 3992.8 | 11.2 Mi, | 4024.7 | 11.6 Cy, |
| | 3993.8 | 11.5 Pt, | 4024.7 | 12.6 Ie. |
| | 3993.8 | 11.3 Mi, | 4027.7 | 10 2 Cm, |
| | 3996.6 | 11.2 Ca, | 4029.9 | 12 8 Br, |
| | 3999.8 | 11.5 Mi, | 4039.8 | 12.6 Br. |
| | 4008.8 | 12.5 Ie, | | |

VARIABLE STAR OBSERVATIONS, July 20 to September 20, 1924—Continued.

| Star | J.D. | Est.Obs. | J.D. | Est.Obs. |
|---|---|---|---|---|
| 021143a W ANDROMEDAE— | | | | |
| | 3993.8 | 13.5 Pt, | 4024.7 | 12.3 Ie, |
| | 4021.8 | 12.4 Pt, | 4029.9 | 12.3 Br. |
| 021258 T PERSEI— | | | | |
| | 3993.8 | 8.2 Pt, | 4030.3 | 8.6 Ch. |
| | 4028.7 | 8.3 Pt, | | |
| 021281 Z CEPHEI— | | | | |
| | 3989.8 | 13.6 Wf, | 4020.7 | 11.6 Wf, |
| | 3993.8 | 12.5 Pt, | 4026.6 | 11.6 Ie, |
| | 3995.7 | 13.2 Wf, | 4028.7 | 11.6 Pt, |
| | 4002.8 | 12.4 Wf, | 4030.7 | 11.3 Wf, |
| | 4009.7 | 12.0 Br, | 4030.7 | 11.3 Wf. |
| *021403* o CETI— | | | | |
| | 3814.3 | 5.2 An, | 4028.6 | 9.4 An, |
| | 3818.3 | 5.0 An, | 4028.7 | 9.1 Pt, |
| | 3978.4 | 8.9 Ch, | 4032.7 | 9.3 Cy, |
| | 3993.8 | 9.0 Pt, | 4032.7 | 9.2 Hr, |
| | 4012.7 | 9.1 Ca, | 4033.7 | 9.3 Kl, |
| | 4024.7 | 9.5 Ca, | 4043.6 | 9.0 Ca. |
| | 4027.7 | 9.2 Cy, | | |
| 021558 S PERSEI— | | | | |
| | 3993.8 | 8.4 Pt, | 4030.3 | 9.3 Ch, |
| | 4000.7 | 8.8 Kl, | 4037.6 | 9.0 Kl. |
| | 4028.7 | 8.7 Pt, | | |
| 022000 R CETI— | | | | |
| | 4024.7 | 8.0 Ca, | 4036.7 | 7.9 Ca, |
| | 4030.7 | 8.0 Ca, | 4043.6 | 8.1 Ca, |
| | 4032.8 | 7.8 Br, | 4048.6 | 8.3 Ca. |
| 022150 RR PERSEI— | | | | |
| | 3989.8 | 11.8 Wf, | 4024.7 | 13.0 Ie, |
| | 3993.8 | 12.1 Pt, | 4028.7 | 13.5 Pt, |
| | 3995.8 | 12.1 Wf, | 4029.9 | 13.5 Br, |
| | 4002.8 | 12.3 Wf, | 4030.7 | 13.0 Wf, |
| | 4020.7 | 12.9 Wf, | 4037.7 | 13.2 Wf. |
| 022813 U CETI— | | | | |
| | 3993.8 | 11.6 Pt, | 4030.7 | 9.1 Ca. |
| | 4028.7 | 8.7 Pt, | | |
| 022980 RR CEPHEI— | | | | |
| | 3989.8 | 11.9 Wf, | 4005.8 | 11.5 Pa, |
| | 3991.8 | 11.5 Pa, | 4020.7 | 10.7 Wf, |
| | 3993.8 | 10.7 Pt, | 4026.6 | 10.7 Ie, |
| | 3995.8 | 11.7 Wf, | 4028.7 | 10.5 Pt, |
| | 3996.7 | 11.8 Br, | 4030.7 | 10.6 Wf, |
| | 4002.8 | 11.0 Wf, | 4036.7 | 10.8 Wf. |
| 023133 R TRIANGULI— | | | | |
| | 3992.8 | 11.2 Mi, | 4019.7 | 11.3 Ie, |
| | 3993.8 | 11.0 Pt, | 4026.7 | 11.0 Mi, |
| | 3993.8 | 11.3 Kl, | 4027.8 | 10.1 Cy, |
| | 4000.8 | 11.4 Mi, | 4028.7 | 10.0 Pt, |
| | 4000.8 | 11.2 M, | 4031.6 | 11.1 Kl. |
| | 4002.7 | 11.1 Ie, | | |
| 024356 W PERSEI— | | | | |
| | 3986.7 | 9.8 Cy, | 4024.7 | 9.8 Cy, |
| | 3992.8 | 9.9 Mi, | 4024.7 | 9.8 Hr, |
| | 3993.7 | 9.8 Mi, | 4025.7 | 9.7 Mi, |
| | 3993.8 | 9.4 Pt, | 4027.6 | 10.0 Cm, |
| | 3994.7 | 9.8 Cm, | 4027.8 | 9.5 M, |
| | 3996.7 | 9.4 Ca, | 4028.7 | 9.2 Pt, |
| | 3999.7 | 9.9 Cm, | 4032.6 | 9.4 O, |
| | 4000.7 | 9.6 Mi, | 4034.7 | 9.9 Mi, |
| 024356 W PERSEI—Continued. | | | | |
| | 4000.7 | 9.4 Kl, | 4038.6 | 9.7 Mi, |
| | 4011.7 | 9.4 Mi, | 4041.6 | 9.3 Kl, |
| | 4012.7 | 9.1 Ca, | 4043.5 | 9.3 Ca, |
| | 4016.6 | 9.9 Cy, | 4049.6 | 9.8 Cm. |
| | 4024.6 | 9.6 Ca, | | |
| 030514 U ARIETIS— | | | | |
| | 4029.9 | 12.8 Br. | | |
| *031401* X CETI— | | | | |
| | 4000.8 | 9.1 Pt, | 4028.7 | 9.9 Pt, |
| | 4006.9 | 9.2 Wf, | 4031.9 | 10.1 Wf, |
| | 4023.9 | 9.5 Wf, | 4032.8 | 10.2 M, |
| | 4024.7 | 10.0 Ca, | 4032.9 | 10.6 Br. |
| 032043 Y PERSEI— | | | | |
| | 4000.8 | 8.4 Pt, | 4028.7 | 8.2 Pt, |
| | 4000.8 | 8.7 M, | 4028.8 | 9.0 M. |
| 032335 R PERSEI— | | | | |
| | 4000.8 | 12.0 Pt, | 4028.7 | 13.1 Pt, |
| | 4000.8 | 11.0 M, | 4028.8 | 12.0 M, |
| | 4006.7 | 12.3 Ca, | 4029.9 | 14.0 Br. |
| 042209 R TAURI— | | | | |
| | 4000.8 | 11.0 Pt, | 4031.8 | 12.0 Pt, |
| | 4028.8 | 12.0 M, | 4032.8 | 12.3 Ca. |
| 042215 W TAURI— | | | | |
| | 4000.8 | 11.1 Pt, | 4029.9 | 10.0 Br, |
| | 4024.8 | 10.5 M, | 4031.8 | 9.4 Pt, |
| | 4027.7 | 10.2 Cy, | 4033.7 | 10.0 Kl. |
| 042309 S TAURI— | | | | |
| | 4000.8 | 11.7 Pt, | 4031.8 | 12.9 Pt. |
| | 4028.8 | 11.0 M, | | |
| 043065 T CAMELOPARDALIS— | | | | |
| | 3975.4 | 8.3 L, | 4026.8 | 9.3 M, |
| | 4000.8 | 7.9 Pt, | 4031.8 | 8.9 Pt, |
| | 4007.8 | 8.3 M, | 4032.8 | 9.2 Br. |
| 043208 RX TAURI— | | | | |
| | 4031.8 | 13.2 Pt. | | |
| 043274 X CAMELOPARDALIS— | | | | |
| | 3987.6 | 10.5 O, | 4030.0 | 12.3 Br, |
| | 4000.8 | 10 9 Pt, | 4039.8 | 11.8 Br. |
| | 4031.8 | 12.2 Pt, | | |
| 044617 V TAURI— | | | | |
| | 4028.8 | 11.8 Ie, | 4031.8 | 10.5 Pt, |
| | 4029.9 | 11.5 Br, | 4039.9 | 10.6 Br. |
| 045307 R ORIONIS— | | | | |
| | 4032.9 | 10.0 Br. | | |
| *045514* R LEPORIS— | | | | |
| | 4031.8 | 7.4 Pt, | 4036.8 | 7.9 Ca. |
| *050022* T LEPORIS— | | | | |
| | 4031.8 | 11.9 Pt. | | |
| 050953 R AURIGAE— | | | | |
| | 4000.8 | 11.8 Pt, | 4031.8 | 12.8 Pt, |
| | 4000.8 | 11.9 Ie, | 4032.8 | 12.7 Br. |
| | 4027.7 | 11.9 Ie, | | |
| 052034 S AURIGAE— | | | | |
| | 4000.8 | 8.4 Pt, | 4033.7 | 9.7 Kl. |
| | 4031.8 | 8.2 Pt, | | |
| 052036 W AURIGAE— | | | | |
| | 4000.8 | 9.4 Pt, | 4032.9 | 11.7 Br. |
| | 4031.8 | 11.6 Pt, | | |

VARIABLE STAR OBSERVATIONS, July 20 to September 20, 1924—Continued.

| Star | J.D. | Est. | Obs. | J.D. | Est. | Obs. |
|---|---|---|---|---|---|---|
| 052404 S ORIONIS— | | | | | | |
| | 4031.8 | 10.5 | Pt, | 4032.8 | 10.5 | Ca. |
| *053005* T ORIONIS— | | | | | | |
| | 3824.3 | 9.9 | An, | 4031.8 | 10.2 | Pt. |
| | 4026.8 | 10.0 | Pt, | | | |
| 043068 S CAMELOPARDALIS— | | | | | | |
| | 4000.8 | 8.6 | Pt, | 4031.8 | 8.4 | Pt. |
| | 4026.8 | 9.0 | M, | | | |
| 053531 U AURIGAE— | | | | | | |
| | 4000.8 | 7.9 | Pt, | 4032.9 | 8.8 | Br, |
| | 4026.8 | 9.0 | M, | 4033.7 | 8.7 | Kl. |
| | 4031.8 | 8.3 | Pt, | | | |
| 054319 SU TAURI— | | | | | | |
| | 4000.8 | 9.5 | Pt, | 4033.0 | 10.3 | Br, |
| | 4006.9 | 9.4 | Wf, | 4033.9 | 10.4 | Wf, |
| | 4023.9 | 9.5 | Wf, | 4034.9 | 10.5 | Wf, |
| | 4026.8 | 9.6 | Wf, | 4035.0 | 10.6 | Br, |
| | 4026.8 | 9.6 | Pt, | 4036.8 | 11.2 | Ca, |
| | 4028.8 | 9.9 | Ie, | 4039.9 | 12.0 | Br, |
| | 4031.8 | 9.8 | Pt, | 4040.9 | 12.1 | Wf, |
| | 4031.9 | 9.8 | Wf, | 4041.8 | 12.4 | Wf, |
| | 4032.9 | 10.0 | Wf, | 4042.7 | [11.5 | Pt. |
| 054920a U ORIONIS— | | | | | | |
| | 4000.8 | 6.2 | Pt, | 4033.0 | 5.5 | Br, |
| | 4012.8 | 5.3 | Ca, | 4036.7 | 5.1 | Ca, |
| | 4024.8 | 5.3 | Ca, | 4043.7 | 5.2 | Ca, |
| | 4029.9 | 5.7 | Cy, | 4048.7 | 5.3 | Ca. |
| | 4031.8 | 5.2 | Pt, | | | |
| 054920b UW ORIONIS— | | | | | | |
| | 4029.9 | 10.8 | Cy. | | | |
| 054974 V CAMELOPARDALIS— | | | | | | |
| | 3990.6 | 11.0 | O, | 4026.6 | 11.1 | Ie, |
| | 3991.8 | 12.0 | Pa, | 4026.8 | 11.2 | M, |
| | 3998.8 | 11.0 | Pa, | 4031.8 | 11.2 | Pt, |
| | 4000.8 | 11.2 | Pt, | 4032.6 | 11.3 | O, |
| | 4004.8 | 10.9 | Pa, | 4032.8 | 11.2 | Br. |
| | 4007.8 | 9.6 | M, | | | |
| 055353 Z AURIGAE— | | | | | | |
| | 3989.8 | 10.6 | Wf, | 4020.7 | 10.1 | Wf, |
| | 3995.8 | 10.4 | Wf, | 4028.8 | 10.0 | M, |
| | 4000.8 | 9.7 | M, | 4029.7 | 9.9 | Wf, |
| | 4000.8 | 9.8 | Pt, | 4031.8 | 9.7 | Pt. |
| | 4002.8 | 10.0 | Wf. | | | |
| 060450 X AURIGAE— | | | | | | |
| | 4000.8 | 11.4 | Pt, | 4027.7 | 11.6 | Ie, |
| | 4004.8 | 11.6 | Ie, | 4031.8 | 11.5 | Pt. |
| 060547 SS AURIGAE— | | | | | | |
| | 3975.6 | [12.4 | L, | 4025.8 | 13.9 | Wf, |
| | 3979.8 | [13.9 | Wf, | 4026.8 | [12.4 | Pt, |
| | 3985.8 | [12.9 | Wf, | 4026.8 | 14.6 | Wf, |
| | 3989.8 | [13.5 | Wf, | 4027.7 | [12.6 | Ie, |
| | 3990.8 | [13.9 | Wf, | 4027.8 | [11.6 | Cy, |
| | 3991.7 | [12.4 | Wf, | 4027.8 | 14.9 | Wf, |
| | 3992.7 | [11.0 | Wf, | 4028.8 | [13.3 | Ie, |
| | 3992.8 | [12.6 | Ie, | 4028.8 | [12.4 | M, |
| | 3994.8 | [12.4 | Wf, | 4029.4 | [13.3 | L, |
| | 3995.8 | [12.4 | Wf, | 4029.8 | 14.8 | Wf, |
| | 3997.8 | [12.4 | Wf, | 4029.9 | [13.3 | Br, |
| | 3999.8 | [13.3 | Wf, | 4029.9 | [11.2 | Cy. |
| 060547 SS AURIGAE—Continued. | | | | | | |
| | 4000.8 | [12.6 | Pt, | 4031.8 | 15.0 | Wf, |
| | 4000.8 | [12.4 | Ie, | 4031.8 | [12.6 | Pt, |
| | 4002.8 | 15.0 | Wf, | 4032.8 | [12.4 | Cy. |
| | 4002.8 | [12.6 | Ie, | 4032.9 | 15.2 | Wf, |
| | 4003.8 | [14.5 | Wf, | 4032.9 | [13.3 | Br, |
| | 4004.8 | [14.5 | Wf, | 4033.7 | [12.6 | Kl, |
| | 4004.8 | [12.6 | Ie, | 4033.7 | [13.3 | Ie, |
| | 4006.8 | [13.3 | Ie, | 4033.7 | 14.8 | Wf, |
| | 4007.9 | 15.5 | Wf, | 4033.7 | [11.6 | Cy, |
| | 4008.8 | [11.4 | Ie, | 4034.8 | 15.0 | Wf, |
| | 4012.8 | [11.4 | Ie, | 4035.7 | [12.6 | Ie, |
| | 4018.7 | 12.4 | Wf, | 4036.7 | [12.4 | Ca, |
| | 4020.7 | 11.0 | Wf, | 4039.7 | [11.4 | Ie, |
| | 4023.9 | 12.5 | Wf, | 4040.9 | [13.5 | Wf, |
| | 4024.7 | 13.6 | Ie, | 4041.7 | [10.8 | Kl, |
| | 4024.8 | 13.5 | Wf, | 4041.8 | [13.3 | Wf, |
| | 4024.8 | [12.4 | Cy, | 4042.7 | [12.4 | Pt, |
| | 4024.8 | [12.4 | Ca, | 4043.7 | [11.0 | Pt, |
| | 4025.7 | [12.4 | Pt, | 4045.7 | [11.6 | Kl. |
| 061702 V MONOCEROTIS— | | | | | | |
| | 4031.8 | 12.8 | Pt. | | | |
| 063558 S LYNCIS— | | | | | | |
| | 4032.9 | 14.2 | Br. | | | |
| 063308 R MONOCEROTIS— | | | | | | |
| | 4031.8 | 10.5 | Pt. | | | |
| 064030 X GEMINORUM— | | | | | | |
| | 4039.9 | 11.5 | Pt. | | | |
| 064707 W MONOCEROTIS— | | | | | | |
| | 4031.8 | 10.1 | Pt. | | | |
| 065111 Y MONOCEROTIS— | | | | | | |
| | 4031.8 | 8.8 | Pt. | | | |
| 065355 R LYNCIS— | | | | | | |
| | 4000.8 | 8.5 | Pt. | 4032.9 | 9.3 | Br. |
| | 4031.8 | 9.3 | Pt. | | | |
| 070122a R GEMINORUM— | | | | | | |
| | 4028.9 | 12.3 | Ie, | 4036.8 | 11.2 | Ca, |
| | 4031.8 | 11.5 | Pt, | | | |
| 070122b Z GEMINORUM— | | | | | | |
| | 4028.9 | 12.6 | Ie, | 4031.8 | 12.4 | Pt. |
| 070122c TW GEMINORUM— | | | | | | |
| | 4031.8 | 8.8 | Pt, | 4036.8 | 8.4 | Ca. |
| 071713 V GEMINORUM— | | | | | | |
| | 4031.8 | 9.1 | Pt. | | | |
| 072708 S CANIS MINORIS— | | | | | | |
| | 4031.8 | 11.8 | Pt. | | | |
| 072811 T CANIS MINORIS— | | | | | | |
| | 4031.8 | 10.6 | Pt. | | | |
| 073508 U CANIS MINORIS— | | | | | | |
| | 4031.8 | 12.8 | Pt. | | | |
| 073723 S GEMINORUM— | | | | | | |
| | 4031.8 | 12.5 | Pt. | | | |
| 074922 U GEMINORUM— | | | | | | |
| | 4023.9 | 13.9 | Wf, | 4032.9 | 13.9 | Wf, |
| | 4028.9 | [12.4 | Ie, | 4033.9 | 14.0 | Wf, |
| | 4029.9 | [9.3 | Cy, | 4034.9 | 14.1 | Wf, |
| | 4031.8 | [12.4 | Pt, | 4046.9 | [12.3 | Wf. |
| | 4031.9 | 13.9 | Wf | | | |

VARIABLE STAR OBSERVATIONS, July 20 to September 20, 1924—Continued.

| Star | J.D. | Est.Obs. | J.D. | Est.Obs. |
|---|---|---|---|---|
| 083350 X URSAE MAJORIS— | | | | |
| | 4031.8 | 10.1 Pt. | | |
| 093178 Y DRACONIS— | | | | |
| | 3993.6 | 9.9 Cy, | 4026.6 | 11.4 Ie, |
| | 3993.6 | 9.8 Hr, | 4033.6 | 11.8 Cy. |
| 094211 R LEONIS— | | | | |
| | 3824.3 | 9.9 An. | | |
| *103212* U HYDRAE— | | | | |
| | 3931.0 | 6.0 Kd, | 3956.0 | 6.1 Kd, |
| | 3940.0 | 5.9 Kd, | 3958.0 | 6.1 Kd. |
| 103769 R URSAE MAJORIS— | | | | |
| | 3990.6 | 11.6 Pt, | 4005.7 | 11.9 Kl, |
| | 3998.6 | 11.8 Lv, | 4020.6 | 12.3 Ie, |
| | 3986.6 | 11.7 Cy, | 4023.6 | 12.5 Pt, |
| | 4000.6 | 11.8 Ca, | 4024.6 | 12.2 Kl, |
| | 4002.6 | 11.8 Ie, | 4032.7 | 12.4 Br. |
| 115919 R COMAE BERENICES— | | | | |
| | 3999.6 | 9.9 Ca, | 4014.6 | 10.0 Kl. |
| *120012* SU VIRGINIS— | | | | |
| | 3990.6 | 11.9 Pt. | | |
| 122532 T CANUM VENATICORUM— | | | | |
| | 3990.6 | 11.3 Pt, | 4023.6 | 12.1 Pt. |
| 123160 T URSAE MAJORIS— | | | | |
| | 4008.6 | 13.3 M, | 4032.6 | 11.1 Ca, |
| | 4016.6 | 12.5 Ie, | 4036.6 | 10.8 O, |
| | 4024.6 | 12.2 Kl, | 4047.5 | 9.6 Ly, |
| | 4025.6 | 11.3 Ly, | 4047.6 | 9.5 Cy, |
| | 4027.6 | 11.5 Cy, | 4048.6 | 9.6 Ca. |
| | 4032.5 | 11.1 Ie, | | |
| 123307 R VIRGINIS— | | | | |
| | 3990.6 | 10.2 Pt, | 3999.6 | 10.1 Ca, |
| | 3990.6 | 9.7 Mi, | 3999.6 | 10.1 Mi. |
| | 3993.6 | 9.9 O, | | |
| 123459 RS URSAE MAJORIS— | | | | |
| | 3971.6 | 8.6 Ch, | 4003.7 | 9.5 Wf, |
| | 3984.6 | 8.7 Mi, | 4006.6 | 9.8 Ca, |
| | 3984.7 | 8.8 Cy, | 4008.6 | 10.1 M, |
| | 3984.7 | 8.8 Cy, | 4008.6 | 10.3 Cy, |
| | 3985.6 | 9.0 O, | 4010.6 | 10.0 Ya, |
| | 3985.6 | 8.6 Js, | 4011.6 | 10.2 Mi, |
| | 3988.6 | 9.0 Ca, | 4012.6 | 10.3 Mi, |
| | 3988.6 | 9.0 Js, | 4016.6 | 10.5 Cy, |
| | 3989.7 | 9.0 Wf, | 4018.6 | 10.9 Mi, |
| | 3990.6 | 9.0 Pt, | 4019.6 | 10.6 Ly, |
| | 3990.6 | 9.2 O, | 4019.6 | 10.4 Js, |
| | 3992.6 | 8.9 Lv. | 4020.7 | 10.7 Wf, |
| | 3992.6 | 9.3 Ly, | 4022.6 | 11.0 Hr, |
| | 3993.6 | 8 8 Js, | 4022.8 | 11.0 Cy, |
| | 3994.1 | 9.0 Ch, | 4023.6 | 11.1 Pt, |
| | 3994.6 | 8.9 Cy, | 4025.6 | 11.3 Ly, |
| | 3994.6 | 8.9 Cy, | 4025.7 | 11.3 Wf, |
| | 3994.6 | 8.8 Lv, | 4026.6 | 11.5 Mi, |
| | 3995.7 | 9.3 Wf, | 4026.6 | 11.3 Cy, |
| | 3996.6 | 8.7 Mi, | 4026.6 | 11.5 Cy, |
| | 3999.6 | 9.5 Ly, | 4032.7 | 11.6 Wf, |
| | 4000.6 | 10.4 O, | 4033.5 | 11.7 Cy, |
| | 4000.6 | 9.4 Ca, | 4039.7 | 12.5 Wf. |
| 123961 S URSAE MAJORIS— | | | | |
| | 3820 2 | 8.6 An, | 4006.5 | 7.8 Ro, |
| | 3823.2 | 8.0 An, | 4010.6 | 8.2 Ya, |
| | 3984.6 | 8.5 Mi, | 4012.3 | 8.1 An, |
| | 3984.7 | 8.6 Cy, | 4012.6 | 8.1 Mi, |
| | 3985.6 | 8.5 O, | 4012.7 | 8.1 Ca, |
| | 3987.4 | 8.7 An, | 4015.5 | 7.6 Ro, |
| | 3987.5 | 8.5 Ro, | 4016.6 | 7.9 Cy, |
| | 3988.7 | 8.4 Ro, | 4018.6 | 8.1 Mi, |
| | 3988.6 | 8.3 Mi, | 4019.6 | 8.2 Ca, |
| | 3990.6 | 8.5 O, | 4019.6 | 8.2 Ly, |
| | 3990 6 | 8.1 Lv, | 4023.3 | 8.3 An, |
| | 3990.6 | 8.2 Pt, | 4023.6 | 8.0 Pt, |
| | 3990.6 | 8.3 Cy, | 4024.6 | 7.6 Kl, |
| | 3992.6 | 8.4 Ly, | 4024.6 | 8.1 Ca, |
| | 3994.7 | 8.2 Ca, | 4025.6 | 7.9 Ly, |
| | 3996.6 | 8.3 B, | 4026.6 | 7.9 Mi, |
| | 3996.6 | 8.2 Mi, | 4026.7 | 7.6 Cy, |
| | 3998.3 | 8.0 An, | 4027.6 | 8.6 Cg, |
| | 3998.7 | 8.3 Lv, | 4032.6 | 7.7 Ca, |
| | 3999.6 | 8.3 Ly, | 4036.6 | 8.0 O, |
| | 4000 6 | 8.3 O, | 4038.6 | 7.9 Mi, |
| | 4000.6 | 8.2 Ca, | 4040.6 | 7.7 Ca, |
| | 4001.5 | 8.0 Ro, | 4047.5 | 8.3 Ly, |
| | 4004.4 | 8.6 An, | 4047.6 | 7.9 Cy, |
| | 4005.6 | 8.0 Ca, | 4048.6 | 8.2 Ca. |
| | 4005.7 | 8.0 Kl, | | |
| 124606 U VIRGINIS— | | | | |
| | 3990.6 | 12.5 Pt. | | |
| *132002* W VIRGINIS— | | | | |
| | 3993.6 | 10.0 B. | | |
| *132202* V VIRGINIS— | | | | |
| | 3993.6 | 9.0 B. | | |
| *132422* R HYDRAE— | | | | |
| | 3931.0 | 6.2 Kd, | 3976.1 | 7.0 Ch, |
| | 3933.0 | 6.7 Kd, | 3985.0 | 7.8 Kd, |
| | 3940.0 | 6.5 Kd, | 3987.0 | 7.9 Kd, |
| | 3956.0 | 7.1 Kd, | 3989.0 | 8.0 Kd, |
| | 3957.0 | 7.2 Kd, | 4001.1 | 7.8 Ch, |
| | 3967.0 | 7.4 Kd, | | |
| 132706 S VIRGINIS— | | | | |
| | 3986.6 | 9.4 Cy, | 3992.6 | 9.6 Mi, |
| | 3986.6 | 9.4 Mi, | 3999.6 | 10.9 Ca, |
| | 3990.6 | 9.4 Pt. | 3999.6 | 9.9 Mi. |
| | 3990.6 | 9.4 Mi, | | |
| 133273 T URSAE MINORIS— | | | | |
| | 3986.8 | 12.4 Br, | 4005.7 | 13.1 Lv, |
| | 3987.7 | 12.9 Wf, | 4020.7 | 13.6 Wf, |
| | 3989.7 | 12.5 Lv, | 4025.7 | 13.9 Wf, |
| | 3995.7 | 13.1 Wf, | 4032.7 | 13.9 Wf. |
| | 4003.7 | 13.1 Wf, | | |
| *133633* T CENTAURI— | | | | |
| | 3931.0 | 7.0 Kd, | 3985.0 | 6.3 Kd, |
| | 3933.0 | 6.8 Kd, | 3986.0 | 6.4 Kd, |
| | 3940.0 | 6.5 Kd, | 3987.0 | 6.4 Kd, |
| | 3956.0 | 6.5 Kd, | 3989.0 | 6.4 Kd, |
| | 3957.0 | 6.3 Kd, | 3995.0 | 6.7 Kd. |
| | 3967.0 | 6.3 Kd, | | |

VARIABLE STAR OBSERVATIONS, July 20 to September 20, 1924—Continued.

| Star | J.D. | Est. | Obs. | J.D. | Est. | Obs. |
|---|---|---|---|---|---|---|
| 134440 R CANUM VENATICORUM— | | | | | | |
| | 3983.7 | 11.7 | Lv, | 4007.6 | 11.4 | Kl, |
| | 3986.7 | 11.1 | Mi, | 4016.6 | 11.0 | Ie, |
| | 3990.6 | 11.9 | Pt, | 4016.6 | 11.0 | Mi, |
| | 3992.7 | 11.7 | Mi, | 4023.6 | 10.4 | Pt, |
| | 3994.6 | 11.8 | Lv, | 4024.6 | 10.7 | Kl, |
| | 3996.7 | 11.9 | Mi, | 4032.6 | 10.7 | Ie. |
| *135908* RR VIRGINIS— | | | | | | |
| | 3990.6 | 11.3 | Pt, | 3992.6 | 11.4 | Mi. |
| | 3990.6 | 11.4 | Mi, | | | |
| 140113 Z BOOTIS— | | | | | | |
| | 3985.6 | 10.6 | B, | 4003.7 | 11.7 | Wf, |
| | 3987.7 | 10.8 | Wf, | 4018.6 | 12.4 | B, |
| | 3995.7 | 11.3 | Wf, | 4020.6 | 12.5 | Wf, |
| | 4000.6 | 11.1 | O, | 4029.6 | 13.0 | Wf. |
| 141567 U URSAE MINORIS— | | | | | | |
| | 3988.7 | 11.6 | Lv, | 4023.6 | 11.5 | Pt, |
| | 3990.6 | 12.1 | Pt, | 4031.2 | 11.0 | Ch, |
| | 3998.7 | 12.0 | Lv, | 4034.6 | 11.9 | Kl. |
| | 4014.6 | 12.0 | Kl, | | | |
| 141954 S BOOTIS— | | | | | | |
| | 3990.6 | 12.0 | Pt, | 4024.6 | 11.0 | Cy, |
| | 4009.6 | 11.9 | Kl, | 4028.6 | 11.3 | Mi, |
| | 4023.6 | 11.2 | Pt, | 4031.6 | 11.2 | Kl, |
| | 4024.6 | 11.3 | Hr, | 4040.6 | 10.8 | Ie. |
| 142205 RS VIRGINIS— | | | | | | |
| | 4004.6 | 13.2 | B. | | | |
| 142539 V BOOTIS— | | | | | | |
| | 3940.0 | 8.2 | Kd, | 4015.6 | 8.8 | Ca, |
| | 3956.0 | 8.0 | Kd, | 4015.7 | 9.4 | Cy, |
| | 3984.6 | 8.2 | Cy, | 4016.7 | 9.2 | Ly, |
| | 3984.6 | 8.1 | Hr, | 4018.6 | 9.2 | Mi, |
| | 3984.6 | 7.7 | Mi, | 4018.6 | 9.3 | B, |
| | 3984.7 | 7.4 | Sg, | 4019.6 | 9.2 | Ly, |
| | 3984.7 | 8.2 | Js, | 4023.6 | 9.4 | Pt, |
| | 3985.7 | 8.0 | B, | 4024.5 | 9.7 | Hr, |
| | 3987.5 | 8.0 | Ro, | 4024.5 | 9.6 | Cy, |
| | 3988.6 | 7.9 | Ca, | 4024.6 | 9.4 | Ly, |
| | 3989.7 | 7.9 | Kl, | 4024.6 | 9.1 | Ca, |
| | 3990.6 | 8.7 | Ly, | 4026.6 | 9.5 | Mi, |
| | 3990.6 | 7.8 | Pt, | 4028.6 | 9.7 | Ly, |
| | 3992.6 | 8.5 | Js, | 4036.6 | 10.5 | Kl, |
| | 3996.6 | 7.8 | Mi, | 4033.6 | 9.8 | Cy, |
| | 3996.6 | 8.3 | Ly, | 4035.6 | 10.3 | Du, |
| | 3999.6 | 8.1 | Ca, | 4036.6 | 10.5 | Ca, |
| | 4005.6 | 8.4 | Ca, | 4046.5 | 10.5 | Ly. |
| | 4012.6 | 9.0 | Mi, | | | |
| 142584 R CAMELOPARDALIS— | | | | | | |
| | 3986.9 | 10.0 | Br, | 4026.8 | 8.7 | Ca, |
| | 3988.7 | 10.0 | Ca, | 4028.6 | 8.3 | Mi, |
| | 3999.6 | 11.2 | O, | 4031.7 | 8.2 | Br, |
| | 4006.6 | 9.3 | Ca, | 4037.6 | 8.3 | Kl, |
| | 4010.6 | 9.2 | Ya, | 4048.6 | 8.7 | Ca. |
| | 4014.7 | 8.7 | Kl, | | | |
| 143227 R BOOTIS— | | | | | | |
| | 3971.2 | 8.1 | Ch, | 4004.6 | 10.2 | M, |
| | 3984.6 | 9.3 | Hr, | 4006.6 | 10.0 | Ca, |
| | 3984.7 | 8.9 | Mi, | 4016.6 | 11.0 | Mi, |
| | 3984.7 | 9.0 | Sg, | 4018.6 | 10.8 | B, |
| | 3985.7 | 8.9 | B, | 4020.6 | 11.0 | Ie, |
| 143227 R BOOTIS—Continued. | | | | | | |
| | 3986.7 | 9.0 | Mi, | 4023.6 | 11.3 | Pt, |
| | 3990.6 | 9.2 | Pt, | 4027.6 | 11.6 | Cy, |
| | 3993.7 | 9.9 | Kl, | 4027.6 | 11.6 | Cy, |
| | 3996.6 | 9.4 | Ca, | 4032.6 | 11.5 | Ca, |
| | 3999.7 | 10.0 | Mi, | 4033.6 | 12.1 | Kl. |
| | 4002.6 | 9.7 | Ie, | | | |
| *143417* V LIBRAE— | | | | | | |
| | 3985.6 | 12.6 | B. | | | |
| 144918 U BOOTIS— | | | | | | |
| | 3985.7 | 11.5 | Cy, | 4013.6 | 11.8 | B, |
| | 3985.7 | 11.5 | Hr, | 4018.6 | 12.0 | B, |
| | 3990.6 | 11.5 | Cy, | 4027.6 | 11.7 | Cy, |
| | 4004.6 | 11.7 | B, | 4033.6 | 11.9 | Cy. |
| | 4006.6 | 10.8 | M, | | | |
| *150519* T LIBRAE— | | | | | | |
| | 3985.6 | 11.2 | B. | 4018.6 | 12.8 | B, |
| | 3990.6 | 11.2 | Pt, | 4023.6 | 12.5 | Pt. |
| 150605 Y LIBRAE— | | | | | | |
| | 3990.6 | 12.8 | Pt, | 3996.6 | 12.8 | B. |
| *151520* S LIBRAE— | | | | | | |
| | 3987.6 | 8.6 | Ch, | 4001.1 | 10.2 | Ch, |
| | 3988.1 | 9.4 | Ch, | 4023.6 | 11.6 | Pt. |
| | 3990.6 | 9.3 | Pt, | | | |
| 151714 S SERPENTIS— | | | | | | |
| | 3987.7 | 10.9 | Wf, | 4019.7 | 8.3 | Cy, |
| | 3990.6 | 11.0 | Ca, | 4021.6 | 8.2 | Ca, |
| | 3990.6 | 10.5 | Pt, | 4023.6 | 8.1 | Pt, |
| | 3993.7 | 10.4 | Kl, | 4025.6 | 8.0 | Kl, |
| | 3995.6 | 10.1 | Mi, | 4026.6 | 8.2 | Ca, |
| | 3995.7 | 10.2 | Wf, | 4027.6 | 8.2 | Mi, |
| | 3996.7 | 9.8 | B, | 4029.6 | 8.3 | Wf, |
| | 4000.6 | 9.6 | O, | 4033.6 | 8.2 | Ca, |
| | 4003.6 | 9.1 | Mi, | 4036.6 | 8.4 | O, |
| | 4003.8 | 9.1 | Wf, | 4037.6 | 7.5 | Kl, |
| | 4015.6 | 7.9 | Ca, | 4041.6 | 7.9 | Kl, |
| | 4018.6 | 8.1 | Wf, | 4043.5 | 8.5 | Ca, |
| | 4019.6 | 8.0 | Cy, | 4047.5 | 8.3 | Cy. |
| 151731 S CORONAE BOREALIS— | | | | | | |
| | 3989.7 | 10 6 | Mi, | 4000.7 | 10.7 | Mi, |
| | 3989 8 | 12.5 | Kl, | 4004.6 | 11.6 | M, |
| | 3990.6 | 12.4 | Pt, | 4022.6 | 12.0 | B, |
| | 3993.7 | 12.0 | Sg, | 4023.6 | 12.3 | Pt, |
| | 3994.7 | 12.6 | Ca, | 4032.6 | 12.2 | Ca, |
| | 3996.7 | 10.7 | Mi, | 4033.6 | 12.3 | Kl. |
| | 3996.7 | 12.3 | B, | | | |
| *151822* RS LIBRAE— | | | | | | |
| | 3985.6 | 10.0 | B. | | | |
| *152714* RU LIBRAE— | | | | | | |
| | 3985.6 | 13.0 | B, | 3990.6 | 13.8 | Pt. |
| 153378 S URSAE MINORIS— | | | | | | |
| | 3986.6 | 10.0 | Cy, | 4009.7 | 11.9 | Kl, |
| | 3987.5 | 10.6 | Ro, | 4015.5 | 11.0 | Ro, |
| | 3988.7 | 10.4 | Ca, | 4023.6 | 10.8 | Pt, |
| | 3988.7 | 10.6 | Mi, | 4024.6 | 11.8 | Cy, |
| | 3990.6 | 10.0 | Pt, | 4026.7 | 10.9 | Mi, |
| | 3999.7 | 10.8 | Mi, | 4026.7 | 11.6 | Ca. |
| | 4005.6 | 10.7 | Ca, | | | |

VARIABLE STAR OBSERVATIONS, July 20 to September 20, 1924—Continued.

| Star | J.D. | Est.Obs. | J.D. | Est.Obs. |
|---|---|---|---|---|
| 154428 R CORONAE BOREALIS— | | | | |
| | 3907.7 | 6.1 Kl, | 4006.0 | 6.2 Kd, |
| | 3928.4 | 6.2 Sl, | 4006.6 | 6.0 Ca, |
| | 3931.0 | 6.3 Kd, | 4006.7 | 6.2 Wf, |
| | 3936.4 | 6.3 An, | 4007.6 | 6.0 Ca, |
| | 3940.0 | 6.0 Kd, | 4007.6 | 6.1 Cy, |
| | 3940.4 | 6.1 An, | 4007.7 | 6.0 Kl, |
| | 3945.5 | 6.3 Sl, | 4007.7 | 6.2 Wf, |
| | 3956.0 | 6.1 Kd, | 4008.6 | 6.2 Pt, |
| | 3958.4 | 6.2 An, | 4008.6 | 6.0 Ie, |
| | 3960.4 | 6.2 An, | 4010.6 | 6.2 Pt, |
| | 3964.4 | 5.9 An, | 4011.6 | 6.1 Pt, |
| | 3967.0 | 6.1 Kd, | 4012.3 | 6.1 An, |
| | 3969.4 | 5.9 An, | 4012.6 | 6.0 Cm, |
| | 3970.2 | 6.0 Ch, | 4012.6 | 6.0 Ie, |
| | 3971.4 | 6.3 Sl, | 4012.6 | 6.2 Pt, |
| | 3971.4 | 6.1 An, | 4012.7 | 6.0 Ca, |
| | 3972.0 | 6.1 Kd, | 4014.6 | 6.0 Gb, |
| | 3974.4 | 6.2 Sl, | 4014.7 | 6.0 Kl, |
| | 3975.0 | 6.1 Kd, | 4015.5 | 6.1 Ca, |
| | 3975.4 | 6.2 Sl, | 4015.5 | 5.6 Ro, |
| | 3977.2 | 5.9 Ch, | 4015.7 | 6.2 Pt, |
| | 3978.8 | 6.1 Wf, | 4016.5 | 6.2 Ie, |
| | 3984.6 | 5.7 Js, | 4016.6 | 5.9 Ie, |
| | 3984.7 | 6.0 Sg, | 4016.7 | 6.2 Cy, |
| | 3984.7 | 6.1 Mi, | 4016.7 | 6.2 Al, |
| | 3985.0 | 6.1 Kd, | 4016.7 | 6.1 Mi, |
| | 3985.6 | 6.0 O, | 4017.4 | 6.0 L, |
| | 3985.6 | 6.2 Cy, | 4017.7 | 6.2 Pt, |
| | 3985.6 | 6.2 Hr, | 4018.0 | 6.2 Kd, |
| | 3985.7 | 6.0 Wf, | 4018.7 | 6.2 Wf, |
| | 3986.4 | 6.3 Sl, | 4019.0 | 6.2 Kd, |
| | 3986.6 | 6.2 Cy, | 4019.6 | 6.0 Ly, |
| | 3986.7 | 6.2 Wf, | 4019.6 | 5.9 Ca, |
| | 3987.4 | 5.8 L, | 4019.6 | 6.0 Kl, |
| | 3987.4 | 5.9 An, | 4019.6 | 5.8 Js, |
| | 3987.4 | 6.3 Sl, | 4019.7 | 6.2 Al, |
| | 3987.6 | 6.2 Pt, | 4019.7 | 6.2 Pt, |
| | 3988.6 | 6.2 Cy, | 4019.7 | 6.3 Cy, |
| | 3988.6 | 5.8 Ca, | 4020.4 | 6.0 An, |
| | 3988.6 | 6.1 Pt, | 4020.6 | 6.2 Ie, |
| | 3988.6 | 5.5 Js, | 4020.6 | 6.3 Cy, |
| | 3989.0 | 6.0 Kd, | 4020.7 | 6.1 Cm, |
| | 3989.6 | 6.1 Pt, | 4020.7 | 6.0 Wf, |
| | 3989.7 | 6.2 Wf, | 4021.6 | 6.2 Pt, |
| | 3990.6 | 6.2 Pt, | 4021.6 | 6.1 Ca, |
| | 3990.6 | 5.8 Ca, | 4022.5 | 6.2 Ie, |
| | 3990.6 | 5.9 O, | 4022.6 | 6.3 Cy, |
| | 3990.7 | 5.9 Ly, | 4022.7 | 6.2 Wf, |
| | 3990.8 | 6.1 Wf, | 4023.1 | 5.8 Ch, |
| | 3991.6 | 6.2 Pt, | 4023.4 | 6.1 An, |
| | 3991.6 | 5.9 Kl, | 4023.6 | 6.1 Pt, |
| | 3991.8 | 6.1 Wf, | 4023.7 | 6.1 Wf, |
| | 3992.4 | 6.1 An, | 4024.5 | 6.2 Ie, |
| | 3992.6 | 5.5 Js, | 4024.6 | 6.3 Cy, |
| | 3992.5 | 6.2 Pt, | 4024.6 | 5.9 Ca, |
| | 3992.7 | 6.0 Wf, | 3924.6 | 5.5 Cg, |
| | 3993.0 | 6.0 Kd, | 4024.6 | 6.2 Pt, |
| | 3993.7 | 6.0 Al, | 4024.7 | 6.0 Kl, |
| | 3993.7 | 6.1 Hr, | 4024.7 | 6.0 Gb, |
| 154428 R CORONAE BOREALIS—Continued | | | | |
| | 3993.7 | 6.1 Cy, | 4024.8 | 6.2 Wf, |
| | 3993.8 | 6.2 Pt, | 4024.6 | 6.2 Al, |
| | 3993.8 | 5.8 Sg, | 4025.6 | 6.1 Pt, |
| | 3994.4 | 6.2 Sl, | 4025.8 | 6.2 Wf, |
| | 3994.6 | 6.0 M, | 4026.5 | 6.1 Ie, |
| | 3994.6 | 6.2 Cv, | 4026.6 | 5.8 Lv, |
| | 3994.6 | 6.2 Cy, | 4026.6 | 6.0 Ca, |
| | 3994.6 | 5.8 Cm, | 4026.6 | 6.3 Cy, |
| | 3994.7 | 6.0 Wf, | 4026.6 | 6.2 Pt, |
| | 3994.7 | 5.8 Ca, | 4027.6 | 6.1 Pt, |
| | 3995.0 | 6.0 Kd, | 4027.6 | 6.3 Cy, |
| | 3995.4 | 6.1 An, | 4027.7 | 6.1 Cm, |
| | 3995.6 | 6.2 Pt, | 4028.4 | 5.9 L, |
| | 3995.6 | 6.0 Cm, | 4028.6 | 6.1 Js, |
| | 3995.7 | 6.1 Wf, | 4028.6 | 6.3 Cy, |
| | 3995.8 | 6.0 Mi, | 4028.6 | 6.1 Pt, |
| | 3996.6 | 6.2 Pt, | 4029.7 | 6.2 Wf, |
| | 3996.6 | 6.0 Ca, | 4030.6 | 6.1 Du, |
| | 3996.7 | 6.0 Ly, | 4030.6 | 6.3 Cy, |
| | 3997.6 | 6.2 Pt, | 4030.7 | 6.0 Kl, |
| | 3997.8 | 6.2 Wf, | 4030.7 | 6.1 Ca, |
| | 3998.4 | 6.3 An, | 4031.1 | 5.8 Ch, |
| | 3998.7 | 6.0 Wf, | 4031.6 | 6.2 Pt, |
| | 3999.4 | 6.3 Sl, | 4031.7 | 6.1 Wf, |
| | 3999.6 | 6.0 Cm, | 4032.6 | 6.2 Pt, |
| | 3999.6 | 6.0 Ca, | 4032.6 | 6.1 Ie, |
| | 3999.6 | 6.0 O, | 4032.6 | 6.0 O, |
| | 3999.6 | 6.2 Pt, | 4032.6 | 6.1 Kl, |
| | 3999.8 | 6.0 Wf, | 4032.6 | 6.1 Ca, |
| | 4000.0 | 6.1 Kd, | 4032.7 | 6.1 Wf, |
| | 4000.1 | 5.8 Ch, | 4033.6 | 6.1 Du, |
| | 4000.4 | 6.2 An, | 4033.6 | 6.1 Ca, |
| | 4000.6 | 6.0 Ie, | 4033.6 | 6.3 Cy, |
| | 4000.6 | 6.2 Pt, | 4033.7 | 6.2 Wf, |
| | 4000.6 | 6.0 Ca, | 4034.6 | 6.2 Pt, |
| | 4000.6 | 6.0 Cm, | 4034.6 | 6.0 Kl, |
| | 4000.7 | 6.3 Cy, | 4034.7 | 6.0 Wf, |
| | 4000.7 | 6.2 Cy, | 4035.6 | 6.1 Du, |
| | 4000.7 | 6.0 Gb, | 4036.6 | 6.1 Ca, |
| | 4001.6 | 6.2 Pt, | 4036.6 | 6.0 O, |
| | 4001.7 | 6.0 Cm, | 4038.6 | 6.1 Pt, |
| | 4001.7 | 6.0 Mi, | 4038.6 | 6.1 Du, |
| | 4001.7 | 6.2 M, | 4039.5 | 6.0 Mi, |
| | 4002.8 | 6.1 Wf, | 4040.6 | 6.1 Du, |
| | 4003.3 | 6.2 Sl, | 4041.6 | 6.0 Kl, |
| | 4003.4 | 6.1 An, | 4043.5 | 5.9 Ca, |
| | 4003.6 | 6.3 Cy, | 4040.6 | 5.9 Ca, |
| | 4003.6 | 6.2 Pt, | 4044.5 | 6.0 Du, |
| | 4003.8 | 6.2 Wf, | 4045.6 | 6.0 Kl, |
| | 4024.7 | 6.2 Wf, | 4046.5 | 6.0 Ly, |
| | 4004.7 | 6.1 Kl, | 4046.7 | 6.2 Pt, |
| | 4005.4 | 6.2 Sl, | 4047.5 | 6.0 Ro, |
| | 4005.4 | 6.2 An, | 4047.6 | 6.3 Cy, |
| | 4005.6 | 6.2 Pt, | 4048.6 | 6.0 Ca, |
| | 4005.8 | 6.0 Sg, | 4049.6 | 6.4 Cm. |
| 154536 X CORONAE BOREALIS— | | | | |
| | 3989.7 | 12.5 Wf, | 4022.6 | 13.3 B, |
| | 3990.6 | 9.7 Pt, | 4022.7 | 12.7 Wf, |
| | 3995.7 | 12.7 Wf, | 4023.6 | 12.5 Pt, |

VARIABLE STAR OBSERVATIONS, July 20 to September 20, 1924—Continued.

| Star | J.D. | Est. | Obs. | J.D. | Est. | Obs. |
|---|---|---|---|---|---|---|
| 154536 X COR. BOR.—Continued. | | | | | | |
| | 3996.7 | 12.5 | B. | 4031.7 | 13.0 | Wf, |
| | 4003.8 | 12.6 | Wf, | 4039.7 | 13.2 | Wf. |
| 154615 R SERPENTIS— | | | | | | |
| | 3986.7 | 11.3 | Cy, | 3996.7 | 11.6 | Mi, |
| | 3986.7 | 11.3 | Mi, | 3996.7 | 12.0 | B, |
| | 3989.7 | 11.3 | Mi, | 4006.6 | 12.3 | B, |
| | 3990.6 | 11.0 | Pt, | 4007.7 | 12.4 | Kl, |
| | 3990.6 | 11.5 | Kl, | 4023.6 | 12.9 | B, |
| | 3990.6 | 11.4 | Ca, | 4023.6 | 13.1 | Pt, |
| | 3993.7 | 13.5 | Sg, | 4024.6 | 12.9 | Kl. |
| 154639 V CORONAE BOREALIS— | | | | | | |
| | 3989.7 | 9.4 | Wf, | 4024.7 | 6.8 | B, |
| | 3990.6 | 7.8 | Pt, | 4026.7 | 7.0 | Ca, |
| | 3994.7 | 9.5 | Cy, | 4027.7 | 7.8 | Cy, |
| | 3995.7 | 9.0 | Wf, | 4030.7 | 8.0 | Wf, |
| | 3996.6 | 8.8 | Ca, | 4033.6 | 6.9 | Ca, |
| | 4003.8 | 8.7 | Wf, | 4036.6 | 7.3 | O, |
| | 4005.6 | 7.8 | B, | 4039.7 | 7.4 | Wf, |
| | 4022.7 | 8.5 | Wf, | 4043.5 | 6.9 | Ca. |
| | 4023.6 | 7.0 | Pt, | | | |
| *154715* R LIBRAE— | | | | | | |
| | 3985.6 | 9.8 | B, | 3996.6 | 10.2 | B, |
| | 3988.6 | 10.0 | O, | 4003.6 | 9.9 | Mi, |
| | 3990.6 | 9.6 | Pt, | 4023.6 | 10.5 | Pt, |
| | 3991.8 | 8.0 | Pa, | 4027.6 | 11.3 | Mi. |
| | 3995.6 | 10.0 | Mi, | | | |
| *155018* RR LIBRAE— | | | | | | |
| | 4023.6 | 11.8 | Pt, | 4027.1 | 11.5 | Ch. |
| 155229 Z CORONAE BOREALIS— | | | | | | |
| | 3986.7 | 11.4 | Cy, | 4022.6 | 13.1 | B, |
| | 3996.7 | 12.3 | B, | 4027.7 | 11.1 | Cy. |
| *155823* RZ SCORPII— | | | | | | |
| | 3990.6 | 10.7 | Pt, | 4023.6 | 12.3 | Pt. |
| | 3999.6 | 11.2 | O, | | | |
| 160210 U SERPENTIS— | | | | | | |
| | 3985.7 | 9.2 | Hr, | 4016.7 | 9.1 | Ly, |
| | 3985.7 | 9.1 | Cy, | 4019.6 | 9.2 | Ly, |
| | 3988.6 | 8.9 | Ca, | 4023.6 | 9.0 | Pt, |
| | 3988.7 | 9.0 | Mi, | 4024.6 | 9.2 | Kl, |
| | 3990.6 | 8.8 | Pt, | 4024.6 | 9.4 | Ly, |
| | 3993.7 | 9.2 | Ly, | 4026.6 | 9.0 | Cy, |
| | 3994.6 | 9.2 | Cy, | 4032.6 | 9.3 | Ca, |
| | 3996.6 | 9.2 | Hr, | 4033.6 | 9.5 | Kl, |
| | 3997.6 | 8.9 | Ca, | 4033.6 | 9.8 | Cy, |
| | 3998.6 | 9.1 | Ly, | 4035.5 | 9.8 | Du, |
| | 3999.7 | 9.0 | Mi, | 4036.6 | 10.2 | O, |
| | 4000.6 | 8.9 | O, | 4039.6 | 10.3 | Mi, |
| | 4001.7 | 9.0 | M, | 4039.6 | 10.3 | Mi, |
| | 4007.7 | 8.8 | Kl, | 4040.5 | 9.7 | Ie, |
| | 4012.6 | 8.9 | Mi, | 4046.6 | 10.6 | Ly, |
| | 4016.6 | 8.9 | B, | 4047.6 | 9.9 | Cy, |
| | 4016.7 | 8.8 | Cy, | | | |
| 160625a RU HERCULIS— | | | | | | |
| | 3975.5 | 8.8 | L, | 4013.6 | 10.0 | B, |
| | 3989.7 | 9.8 | Wf, | 4018.6 | 10.1 | B, |
| | 3990.6 | 9.8 | Pt, | 4022.7 | 10.6 | Wf, |
| | 3995.7 | 10.4 | Mi, | 4023.6 | 10.5 | Pt, |
| | 3995.7 | 10.2 | Wf, | 4027.6 | 10.7 | Mi, |
| 160625a RU HERCULIS—Continued. | | | | | | |
| | 4001.7 | 9.7 | M, | 4029.4 | 10.8 | L, |
| | 4003.6 | 10.3 | Mi, | 4031.7 | 10.6 | Wf, |
| | 4003.8 | 10.2 | Wf, | 4039.7 | 11.2 | Wf. |
| | 4004.7 | 10.6 | Mi, | | | |
| 160625b SX HERCULIS— | | | | | | |
| | 3975.5 | 8.6 | L, | 4010.6 | 9.2 | Pt, |
| | 3987.6 | 9.2 | Pt, | 4011.6 | 9.2 | Pt, |
| | 3988.6 | 9.2 | Pt, | 4012.6 | 8.8 | Pt, |
| | 3989.6 | 9.0 | Pt, | 4015.7 | 8.4 | Pt, |
| | 3989.7 | 9.0 | Wf, | 4019.7 | 8.4 | Pt, |
| | 3990.6 | 8.9 | Pt, | 4022.7 | 8.1 | Wf, |
| | 3992.6 | 9.3 | Pt, | 4023.6 | 8.0 | Pt, |
| | 3995.6 | 9.5 | Pt, | 4025.6 | 8.0 | Pt, |
| | 3995.7 | 9.1 | Wf, | 4027.6 | 8.0 | Pt, |
| | 3996.6 | 9.3 | Pt, | 4028.6 | 7.9 | Pt, |
| | 3997.6 | 9.2 | Pt, | 4029.4 | 7.7 | L, |
| | 3999.6 | 9.2 | Pt, | 4031.6 | 8.0 | Pt, |
| | 4000.6 | 9.2 | Pt, | 4031.7 | 8.0 | Wf, |
| | 4001.6 | 9.4 | Pt, | 4032.6 | 8.0 | Pt, |
| | 4003.6 | 9.4 | Pt, | 4034.6 | 8.0 | Pt, |
| | 4003.8 | 9.1 | Wf, | 4038.6 | 8.0 | Pt, |
| | 4005.6 | 9.4 | Pt, | 4039.7 | 7.8 | Wf, |
| | 4008.6 | 9.2 | Pt, | 4046.7 | 8.2 | Pt. |
| *161122a* R SCORPII— | | | | | | |
| | 3991.8 | 15.0 | Pa. | | | |
| *161122b* S SCORPII— | | | | | | |
| | 3990.6 | 13.4 | Pt, | 3994.6 | 12.6 | M, |
| | 3991.8 | 13.7 | Pa, | 4023.6 | 10.9 | Pt. |
| 161138 W CORONAE BOREALIS— | | | | | | |
| | 3990.6 | 12.0 | Pt, | 4023.6 | 13.2 | Pt. |
| | 4005.6 | 12.9 | B, | | | |
| *162112* V OPHIUCHI— | | | | | | |
| | 3990.6 | 8.6 | Pt, | 4000.6 | 9.8 | Ca, |
| | 3990.6 | 9.6 | O, | 4023.6 | 9.4 | Pt. |
| 162119 U HERCULIS— | | | | | | |
| | 3973.1 | 9.0 | Ch, | 4011.7 | 9.5 | Mi, |
| | 3984.6 | 9.4 | Js, | 4013.6 | 9.3 | B, |
| | 3984.7 | 9.2 | Mi, | 4013.6 | 9.8 | Js, |
| | 3984.7 | 8.9 | Sg, | 4016.6 | 9.6 | Js, |
| | 3988.6 | 9.3 | Ca, | 4022.5 | 9.8 | Ie, |
| | 3988.7 | 9.4 | Js, | 4023.6 | 9.4 | Pt, |
| | 3990.6 | 8.8 | Pt, | 4024.6 | 9.3 | B, |
| | 3990.7 | 9.0 | Js, | 4026.6 | 10.3 | Js, |
| | 3992.8 | 9.2 | Mi, | 4026.7 | 10.0 | Mi, |
| | 3996.7 | 9.3 | Mi, | 4026.7 | 9.7 | Ca, |
| | 3994.6 | 9.4 | Js, | 4027.7 | 9.9 | Cm, |
| | 4005.8 | 9.2 | Sg, | 4033.6 | 10.4 | Js, |
| | 4006.6 | 9.3 | Ie, | 4040.6 | 10.0 | Ca. |
| | 4006.6 | 9.6 | Ca, | | | |
| *162319* Y SCORPII— | | | | | | |
| | 3991.8 | 11.8 | Pa, | 3996.6 | 11.7 | B. |
| 162807 SS HERCULIS— | | | | | | |
| | 3990.6 | 9.6 | Pt, | 4013.6 | 11.8 | B, |
| | 3995.7 | 10.1 | Mi, | 4023.6 | 12.1 | Pt. |
| | 4003.7 | 11.1 | Mi, | | | |
| *162816* S OPHIUCHI— | | | | | | |
| | 4000.7 | 10.0 | Kl, | 4007.6 | 10.0 | Kl. |

VARIABLE STAR OBSERVATIONS, July 20 to September 20, 1924—Continued.

| Star | J.D. | Est. | Obs. | J.D. | Est. | Obs. |
|---|---|---|---|---|---|---|
| 163137 W HERCULIS— | | | | | | |
| | 3973.1 | 11.0 | Ch, | 4006.6 | 8.8 | Ca, |
| | 3990.6 | 9.4 | Pt, | 4016.6 | 8.4 | B, |
| | 3994.2 | 9.4 | Ch, | 4023.6 | 8.2 | Pt, |
| | 3994.7 | 9.2 | Ca, | 4024.7 | 8.3 | Ca, |
| | 3995.7 | 9.4 | Mi, | 4027.1 | 8.3 | Ch, |
| | 4001.7 | 8.8 | M, | 4027.6 | 8.5 | Mi, |
| | 4002.8 | 8.9 | Mi, | 4038.6 | 8.4 | Mi, |
| | 4004.2 | 8.7 | Ch, | 4039.5 | 8.2 | Ie, |
| | 4004.8 | 9.0 | Mi, | 4043.6 | 8.2 | Ca. |
| 163266 R DRACONIS— | | | | | | |
| | 3971.2 | 11.0 | Ch, | 4006.7 | 11.9 | Ca, |
| | 3990.6 | 11.5 | Pt, | 4023.6 | 11.9 | Pt, |
| | 3995.7 | 11.6 | Mi, | 4031.7 | 11.8 | Br, |
| | 4002.8 | 11.8 | Mi, | 4032.8 | 11.4 | Ca. |
| | 4004.7 | 11.9 | B, | | | |
| *164319* RR OPHIUCHI— | | | | | | |
| | 3990.6 | 13.2 | Pt. | | | |
| 164715 S HERCULIS— | | | | | | |
| | 3984.7 | 8.4 | Mi, | 4011.7 | 8.3 | Mi, |
| | 3988.6 | 7.8 | Ca, | 4012.7 | 8.2 | Ca, |
| | 3990.6 | 8.2 | Pt, | 4017.7 | 8.4 | Pa, |
| | 3990.7 | 8.5 | Mi, | 4023.6 | 8.6 | Pt, |
| | 3994.7 | 7.9 | Ca, | 4027.6 | 8.6 | Js, |
| | 3996.7 | 8.6 | Mi, | 4033.6 | 8.6 | Ca, |
| | 4000.6 | 8.5 | Mi, | 4033.6 | 8.8 | Js, |
| | 4000.7 | 7.9 | Ca, | 4040.5 | 8.6 | Ie, |
| | 4005.6 | 8.0 | Ca, | 4043.5 | 8.6 | Ca. |
| *165030* RR SCORPII— | | | | | | |
| | 3999.6 | 8.5 | O. | | | |
| *165202* SS OPHIUCHI— | | | | | | |
| | 3990.6 | 9.0 | Ya, | 3990.6 | 9.2 | O. |
| 165631 RV HERCULIS— | | | | | | |
| | 3984.8 | 11.0 | Sg, | 4005.8 | 10.8 | Sg, |
| | 3987.7 | 10.9 | Lv, | 4015.6 | 11.3 | Mi, |
| | 3988.7 | 10.5 | Mi, | 4016.7 | 10.8 | B, |
| | 3989.7 | 10.4 | Mi, | 4018.6 | 11.2 | Mi, |
| | 3990.6 | 10.4 | Pt, | 4023.6 | 11.1 | Pt, |
| | 3994.7 | 10.4 | Lv, | 4025.7 | 11.5 | Mi, |
| | 3999.7 | 10.8 | Mi, | 4034.7 | 11.8 | Mi, |
| | 4000.7 | 10.8 | Mi, | 4039.5 | 12.0 | Ie. |
| *170215* R OPHIUCHI— | | | | | | |
| | 3970.2 | 7.6 | Ch, | 4009.6 | 8.1 | Kl, |
| | 3976.1 | 7.7 | Ch, | 4011.6 | 7.2 | Mi, |
| | 3984.7 | 7.7 | Mi, | 4012.6 | 7.6 | Ie, |
| | 3985.6 | 8.0 | Js, | 4013.6 | 8.3 | Js, |
| | 3986.7 | 7.6 | Mi, | 4016.6 | 8.2 | Ly, |
| | 3988.6 | 7.5 | Ca, | 4016.6 | 8.4 | Js, |
| | 3989.6 | 7.9 | Kl, | 4016.7 | 8.4 | Cy, |
| | 3990.6 | 7.5 | Js, | 4023.6 | 8.0 | Pt, |
| | 3990.6 | 7.9 | O, | 4024.6 | 8.3 | B, |
| | 3990.6 | 8.0 | Ya, | 4024.6 | 8.5 | Kl, |
| | 3990.7 | 8.1 | Ly, | 4024.6 | 8.2 | Ly, |
| | 3992.7 | 8.0 | Cy, | 4026.5 | 8.5 | Ie, |
| | 3994.7 | 7.5 | Ca, | 4027.1 | 8.5 | Ch, |
| | 3996.6 | 8.0 | Ly, | 4027.5 | 8.3 | Cy, |
| | 3998.6 | 8.4 | Ca, | 4032.5 | 8.5 | Ca, |
| | 3999.7 | 7.6 | Cm, | 4046.6 | 9.4 | Ly, |
| | 4001.1 | 7.7 | Ch, | 4047.5 | 9.3 | Cy. |
| | 4005.6 | 7.7 | Ca, | | | |
| 170627 RT HERCULIS— | | | | | | |
| | 3989.7 | 11.7 | Wf, | 4004.7 | 12.3 | Wf, |
| | 3990.6 | 11.5 | Ya, | 4020.8 | 12.9 | Wf, |
| | 3990.6 | 11.6 | Pt, | 4022.7 | 12.8 | Wf, |
| | 3995.7 | 12.4 | Mi, | 4031.8 | 13.2 | Wf, |
| | 3995.7 | 11.6 | Wf, | 4033.6 | 13.2 | Pt. |
| | 4003.7 | 12.3 | Mi, | | | |
| 171401 Z OPHIUCHI— | | | | | | |
| | 3990.6 | 12.7 | Pt, | 4023.6 | 12.5 | B, |
| | 3999.6 | 12.6 | Ca, | 4023.6 | 12.3 | Pt. |
| 171723 RS HERCULIS— | | | | | | |
| | 3989.7 | 11.4 | Wf, | 4009.7 | 9.3 | Kl, |
| | 3990.6 | 10.9 | Pt, | 4022.7 | 8.9 | Wf, |
| | 3995.7 | 10.8 | Wf, | 4031.8 | 8.1 | Wf, |
| | 4004.7 | 9.6 | Wf, | 4023.6 | 8.7 | Pt. |
| | 4001.7 | 9.4 | M, | 4033.7 | 8.3 | Kl. |
| 172809 RU OPHIUCHI— | | | | | | |
| | 4015.6 | 11.2 | M, | 4036.6 | 9.1 | O. |
| | 4023.6 | 9.2 | Pt, | | | |
| 174406 RY HERCULIS— | | | | | | |
| | 3990.6 | 11.2 | Pt, | 4023.6 | 11.2 | Pt. |
| | 3997.6 | 10.5 | O, | | | |
| 175111 RT OPHIUCHI— | | | | | | |
| | 3990.6 | 12.6 | Pt. | | | |
| 175458a T DRACONIS— | | | | | | |
| | 4015.6 | 12.6 | M. | | | |
| 175458b UY DRACONIS— | | | | | | |
| | 4015.6 | 10.4 | M. | | | |
| 175519 RY HERCULIS— | | | | | | |
| | 3973.1 | 8.4 | Ch, | 3998.7 | 10.2 | Lv, |
| | 3988.7 | 9.7 | Lv, | 4000.7 | 10.5 | M, |
| | 3988.7 | 9.3 | Lv, | 4023.6 | 12.1 | Pt, |
| | 3990.6 | 10.0 | Pt, | 4025.6 | 11.9 | Mi. |
| | 3998.7 | 10.4 | Lv, | | | |
| 175654 V DRACONIS— | | | | | | |
| | 3990.6 | 13.5 | Pt, | 4025.6 | 14.3 | Pt. |
| 180531 T HERCULIS— | | | | | | |
| | 3975.5 | 9.9 | L, | 4016.7 | 7.8 | Ly, |
| | 3986.7 | 9.5 | Br, | 4019.7 | 7.8 | Ly, |
| | 3989.8 | 8.9 | Ca, | 4020.6 | 7.5 | Ie, |
| | 3990.6 | 8.7 | Pt, | 4024.7 | 7.6 | Ca, |
| | 3992.8 | 8.6 | Mi, | 4024.7 | 8.2 | Ly, |
| | 3993.7 | 8.9 | Ly, | 4025.6 | 8.0 | Pt, |
| | 3996.7 | 8.2 | Mi, | 3925.7 | 7.8 | Al, |
| | 3998.6 | 8.2 | Ly, | 4026.7 | 8.1 | Mi, |
| | 4000.7 | 8.1 | Ca, | 4028.6 | 8.5 | Js, |
| | 4001.6 | 7.9 | Ie, | 4029.4 | 8.0 | L, |
| | 4001.7 | 7.6 | M, | 4032.7 | 7.7 | Ca, |
| | 4005.8 | 7.4 | Sg, | 4033.7 | 8.2 | Kl, |
| | 4006.7 | 7.4 | Ca, | 4038.6 | 8.5 | Mi, |
| | 4011.7 | 7.3 | Mi, | 4043.6 | 8.8 | Ca, |
| | 4012.7 | 7.6 | Ca, | 4047.6 | 8.9 | Mi. |
| 180565 W DRACONIS— | | | | | | |
| | 3989.7 | 10.0 | Lv, | 3999.7 | 9.7 | Lv, |
| | 3990.6 | 9.8 | Pt, | 4025.6 | 9.8 | Pt. |
| 180666 X DRACONIS— | | | | | | |
| | 3998.7 | 14.0 | Lv. | | | |
| 180911 NOVA OPHIUCHI— | | | | | | |
| | 3992.6 | 13.6 | Pt. | | | |

VARIABLE STAR OBSERVATIONS, July 20 to September 20, 1924—Continued.

| Star | J.D. | Est.Obs. | J.D. | Est.Obs. |
|---|---|---|---|---|
| 181031 TV HERCULIS— | | | | |
| | 3975.6 | 9.9 L, | 4029.4 | 13.5 L. |
| 181103 RY OPHIUCHI— | | | | |
| | 3983.7 | 9.4 Lv, | 4000.6 | 8.1 Kl, |
| | 3988.6 | 9.2 Ca, | 4000.7 | 9.1 Ca, |
| | 3990.6 | 9.0 O, | 4004.7 | 9.2 Lv, |
| | 3992.6 | 8.4 Pt, | 4015.6 | 9.6 Ca, |
| | 3992.7 | 9.1 Lv, | 4025.6 | 10.0 Pt, |
| | 3994.6 | 8.7 Ya, | 4032.6 | 11.0 Ca. |
| | 3994.7 | 8.9 Ca, | | |
| 181136 W LYRAE— | | | | |
| | 3975.8 | 9.8 L, | 4019.7 | 7.9 Al, |
| | 3986.6 | 9.4 Mi, | 4024.7 | 7.4 Ca, |
| | 3989.8 | 9.1 Mi, | 4025.6 | 7.6 Pt, |
| | 3989.8 | 9.2 Ca, | 4027.7 | 8.4 Js, |
| | 3992.6 | 9.2 Pt, | 4030.7 | 8.6 Js, |
| | 3992.8 | 8.9 Mi, | 4037.7 | 7.7 Kl, |
| | 3994.6 | 8.8 Ya, | 4034.7 | 7.8 Mi, |
| | 3996.8 | 8.7 Mi, | 4035.6 | 8.1 Js, |
| | 4000.7 | 9.0 Ca, | 4036.5 | 8.0 Pi, |
| | 4001.7 | 8.6 M, | 4036.7 | 7.4 Ca, |
| | 4006.7 | 7.7 Ca, | 4038.6 | 8.3 Mi, |
| | 4010.7 | 8.3 Mi, | 4043.6 | 7.6 Ca, |
| | 4011.7 | 8.2 Mi, | 4047.6 | 8.0 Al, |
| | 4012.7 | 7.6 Ca, | 4048.6 | 8.0 Ca. |
| 182224 SV HERCULIS— | | | | |
| | 3975.6 | 12.3 L, | 3986.8 | 13.1 Br. |
| 182306 T SERPENTIS— | | | | |
| | 4000.6 | 12.6 B. | | |
| 183308 X OPHIUCHI— | | | | |
| | 3975.6 | 8.6 L, | 4019.7 | 8.6 Al, |
| | 3985.7 | 8.4 Cy, | 4023.6 | 8.7 B, |
| | 3985.7 | 8.5 Hr, | 4024.7 | 8.6 Ly, |
| | 3988.6 | 8.8 Ca, | 4025.6 | 8.0 Pt, |
| | 3992.6 | 8.4 Pt, | 4027.6 | 8.7 Cy, |
| | 3992.7 | 8.7 Cy, | 4028.6 | 8.3 Ly, |
| | 3993.6 | 8.6 Ly, | 4032.7 | 8.6 Ca, |
| | 3994.6 | 8.6 Ya, | 4033.6 | 8.4 Cy, |
| | 3996.8 | 8.4 Ly, | 4036.6 | 8.5 O, |
| | 4016.7 | 9.1 Cy, | 4046.6 | 8.3 Ly, |
| | 4016.7 | 8.7 Ly, | 4047.6 | 8.5 Al. |
| *184205* R SCUTI— | | | | |
| | 3931.0 | 5.4 Kd, | 4002.7 | 6.0 Cy, |
| | 3936.3 | 5.4 Kd, | 4002.7 | 5.9 Gb, |
| | 3936.4 | 5.9 An, | 4003.4 | 6.3 An, |
| | 3939.4 | 5.9 An, | 4003.4 | 6.0 Sl, |
| | 3944.4 | 5.5 Sl, | 4003.6 | 6.0 Pt, |
| | 3945.4 | 5.2 Sl, | 4003.6 | 6.1 Cy, |
| | 3955.7 | 5.3 Pt, | 4004.7 | 5.9 Kl, |
| | 3956.0 | 5.2 Kd, | 4005.2 | 5.9 Kd, |
| | 3956.7 | 5.3 Pt, | 4005.4 | 6.1 Sl, |
| | 3957.0 | 5.1 Kd, | 4005.4 | 6.4 An, |
| | 3957.4 | 5.3 Sl, | 4005.6 | 5.9 Ca, |
| | 3958.4 | 5.9 An, | 4006.0 | 5.9 Kd, |
| | 3958.8 | 5.3 Pt, | 4006.6 | 6.0 Ca, |
| | 3960.6 | 5.2 Pt, | 4005.6 | 6.0 Pt, |
| | 3961.4 | 5.1 Sl, | 4007.6 | 6.1 Cy, |
| | 3962.7 | 5.4 Pt, | 4007.7 | 5.8 Kl, |
| | 3964.4 | 5.8 An, | 4008.6 | 6.0 Pt, |
| | 3964.6 | 5.4 Pt, | 4010.6 | 6.1 Pt, |
| *184205* R SCUTI—Continued. | | | | |
| | 3965.8 | 5.4 Pt, | 4011.6 | 6.1 Pt, |
| | 3966.7 | 5.3 Pt, | 4012.3 | 6.5 An, |
| | 3967.0 | 5.5 Kd, | 4012.6 | 6.4 Ca, |
| | 3967.8 | 5.4 Pt, | 4012.6 | 6.1 Pt, |
| | 3968.1 | 5.6 Kd, | 4012.6 | 6.4 Ie, |
| | 3986.6 | 5.5 Pt, | 4013.6 | 6.0 Js, |
| | 3969.4 | 5.8 An, | 4014.6 | 6.2 Kl, |
| | 3970.7 | 5.5 Pt, | 4014.6 | 6.3 Gb, |
| | 3971.4 | 5.8 An, | 4015.5 | 6.1 Ro, |
| | 3971.4 | 5.1 Sl, | 4015.6 | 6.3 Ca, |
| | 3971.6 | 5.6 Pt, | 4015.7 | 6.2 Pt, |
| | 3972.2 | 5.7 Kd, | 4016.6 | 6.4 Ly, |
| | 3972.6 | 5.5 Pt, | 4016.6 | 6.2 Js, |
| | 3974.4 | 5.6 Sl, | 4016.6 | 6.4 Ie. |
| | 3975.0 | 5.6 Kd, | 4016.7 | 6.1 Al, |
| | 3975.4 | 5.4 Sl, | 4016.7 | 6.4 Cy, |
| | 3977.2 | 5.7 Kd, | 4017.7 | 6.1 Pt. |
| | 3977.4 | 5.9 An, | 4019.0 | 5.9 Kd, |
| | 3977.6 | 5.2 Pt, | 4019.6 | 6.5 Ca, |
| | 3978.7 | 5.2 Pt, | 4019.6 | 6.6 Kl, |
| | 3979.7 | 5.3 Pt, | 4019.6 | 6.4 Ly, |
| | 3981.0 | 5.6 Kd, | 4019.7 | 6.8 Cy, |
| | 3982.7 | 5.4 Pt, | 4019.7 | 6.5 Pt, |
| | 3983.6 | 5.3 Pt, | 4020.4 | 6.5 An, |
| | 3984.6 | 5.0 Js, | 4020.6 | 6.7 Ie, |
| | 3984.7 | 5.5 Mi, | 4020.6 | 6.6 Cm, |
| | 3985.0 | 5.6 Kd, | 4020.6 | 6.9 Cy, |
| | 3985.7 | 5.5 Hr, | 4020.6 | 6.4 Kl, |
| | 3985.7 | 5.7 Cy, | 4021.0 | 6.4 Kd, |
| | 3986.0 | 5.6 Kd, | 4021.4 | 6.9 An, |
| | 3986.6 | 5.8 Cy, | 4021.6 | 6.4 Ca, |
| | 3986.6 | 5.8 O, | 4022.6 | 6.9 Ie, |
| | 3986.7 | 5.5 Mi, | 4022.6 | 6.4 Cy, |
| | 3987.4 | 5.9 Sl, | 4022.6 | 6.1 Hr, |
| | 3987.4 | 5.9 An, | 4023.4 | 6.7 An, |
| | 3987.5 | 5.7 Ro, | 4023.6 | 6.7 Pt, |
| | 3987.6 | 5.4 Pt, | 4024.5 | 6.9 Ie, |
| | 3988.6 | 5.5 Cy, | 4024.6 | 6.5 Kl, |
| | 3988.6 | 5.2 Js, | 4024.6 | 6.7 Ly, |
| | 3988.6 | 5.5 Pt, | 4024.6 | 6.5 Ca, |
| | 3988.6 | 5.7 Ca, | 4024.6 | 6.8 Gb, |
| | 3989.0 | 5.5 Kd, | 4024.7 | 6.9 Cy, |
| | 3989.6 | 5.5 Pt, | 4025.5 | 6.9 Ie, |
| | 3990.6 | 5.9 Pt, | 4025.6 | 6.6 Pt, |
| | 3990.6 | 5.8 O, | 4025.6 | 6.5 Al, |
| | 3990.6 | 6.0 Cv, | 4026.6 | 7.0 Cy, |
| | 3990.6 | 5.7 Ca, | 4026.6 | 6.7 Js, |
| | 3990.6 | 5.8 Cy, | 4026.6 | 6.6 Ca, |
| | 3990.7 | 5.6 Ly, | 4026.6 | 6.5 Ly, |
| | 3991.6 | 5.9 Kl, | 4027.5 | 7.0 Ie, |
| | 3991.6 | 5.7 Pt, | 4027.6 | 7.0 Cy, |
| | 3991.8 | 5.6 Sg, | 4027.6 | 7.0 Kl, |
| | 3992.4 | 6.0 An, | 4027.6 | 6.6 Pt, |
| | 3992.6 | 4.9 Js, | 4027.6 | 6.6 Cm, |
| | 3992.7 | 5.9 Pt, | 4028.4 | 6.9 An, |
| | 3992.7 | 5.8 Cy, | 4028.5 | 6.7 Ro, |
| | 3993.0 | 5.6 Kd, | 4028.6 | 6.8 Pt, |
| | 3993.6 | 5.8 O, | 4028.6 | 7.0 Cy, |
| | 3993.7 | 5.8 Hr, | 4028.6 | 6.5 Js, |

VARIABLE STAR OBSERVATIONS, July 20 to September 20, 1924—Continued.

| Star | J.D. | Est. | Obs. | J.D. | Est. | Obs. |
|---|---|---|---|---|---|---|
| *184205* R Scuti—Continued. | | | | | | |
| | 3993.7 | 5.8 | Cy, | 4029.4 | 6.6 | L, |
| | 3993.7 | 5.6 | Kl, | 4029.5 | 6.9 | Ie, |
| | 3993.8 | 5.7 | Pt, | 4030.5 | 7.0 | Cy, |
| | 3994.4 | 6.0 | Sl, | 4030.7 | 6.4 | Ca, |
| | 3994.6 | 5.8 | Cv, | 4031.6 | 6.7 | Pt, |
| | 3994.6 | 5.8 | Cm, | 4031.6 | 6.8 | Gb, |
| | 3994.6 | 4.8 | Js, | 4031.6 | 6.9 | Kl, |
| | 3994.7 | 5.8 | Ca, | 4032.6 | 6.8 | Kl, |
| | 3995.0 | 5.6 | Kd, | 4032.6 | 7.1 | O, |
| | 3995.4 | 6.0 | An, | 4032.6 | 6.9 | Ie, |
| | 3995.6 | 6.0 | Pt, | 4032.6 | 6.7 | Pt, |
| | 3996.6 | 5.8 | Ca, | 4033.5 | 6.5 | Ca, |
| | 3996.6 | 5.7 | Ly, | 4033.6 | 7.0 | Cy, |
| | 3996.6 | 6.0 | Pt, | 4033.6 | 6.7 | Js, |
| | 3996.8 | 5.8 | Mi, | 4033.7 | 6.8 | Kl, |
| | 3997.0 | 5.6 | Kd, | 4034.6 | 6.7 | Kl, |
| | 3997.6 | 5.9 | Pt, | 4034.6 | 6.6 | Pt, |
| | 3997.7 | 5.8 | Ca, | 4034.7 | 6.5 | Gb, |
| | 3998.4 | 6.1 | An, | 4036.6 | 6.5 | Ca, |
| | 3999.4 | 6.1 | Sl, | 4037.6 | 6.9 | Kl, |
| | 3999.6 | 5.8 | Ca, | 4038.6 | 6.8 | Pt, |
| | 3999.6 | 5.9 | Pt, | 4040.6 | 6.5 | Ca, |
| | 3999.6 | 6.0 | O, | 4041.6 | 6.8 | Kl, |
| | 3999.7 | 5.8 | Ly, | 4042 7 | 6.5 | Pt, |
| | 3999.7 | 5.9 | Cm, | 4043.5 | 6.5 | Ca, |
| | 4000.0 | 5.6 | Kd, | 4043.7 | 6.5 | Pt, |
| | 4000.4 | 6.4 | An, | 4044.6 | 6.5 | Gb, |
| | 4000.6 | 6.0 | Ie, | 4045.6 | 6.8 | Kl, |
| | 4000.6 | 5.8 | Ca, | 4046.6 | 6.4 | Ly, |
| | 4000.6 | 6.1 | Pt, | 4046.7 | 6.5 | Pt, |
| | 4000.7 | 5.9 | Kl, | 4047.5 | 6.5 | Ro, |
| | 4000.7 | 6.0 | Cy, | 4047.6 | 7.0 | Cy, |
| | 4001.5 | 5.9 | Ro, | 4048.6 | 6.3 | Ca, |
| | 4001.6 | 6.0 | Pt. | 4049.6 | 6.5 | Cm. |
| | 4002.4 | 6.3 | An, | | | |
| 184300 Nova Aquilae— | | | | | | |
| | 3976.1 | 10.4 | Ch, | 4012.6 | 10.4 | Ie, |
| | 3987.5 | 10.6 | Ro, | 4014.6 | 10.5 | Kl, |
| | 3989.6 | 10.7 | Pt, | 4015.5 | 10.6 | Ro, |
| | 3991.8 | 10.4 | Sg, | 4019.7 | 10.8 | Pt, |
| | 3995.8 | 10.1 | Mi, | 4025.6 | 10.4 | Ie, |
| | 4000.7 | 10.3 | Ca, | 4025.6 | 10.5 | Pt, |
| | 4001.5 | 10.5 | Ro, | 4027.6 | 10.3 | Mi, |
| | 4001.7 | 10.5 | M, | 4031.6 | 10.2 | Kl, |
| | 4002.5 | 10.5 | Ro, | 4033.6 | 10.3 | Ca, |
| | 4003.6 | 10.8 | Pt, | 4047.5 | 10 :9 | Ro. |
| | 4004.8 | 10.3 | Mi, | | | |
| 185032 RX Lyrae— | | | | | | |
| | 3976.2 | 12.6 | Ch, | 4015.6 | 14.5 | M, |
| | 3986.8 | 12.7 | Br, | 4025.6 | 13.5 | Pt. |
| | 3992.6 | 13.0 | Pt, | | | |
| 185634 Z Lyrae— | | | | | | |
| | 3992.7 | 13.2 | Pt, | 3998.6 | 14.1 | B. |
| 185737 RT Lyrae— | | | | | | |
| | 3977.2 | 9.3 | Ch, | 3986.8 | 10.2 | Br. |
| *185905* V Aquilae— | | | | | | |
| | 3944.4 | 7.1 | Sl, | 3987.4 | 7.4 | Sl, |
| | 3945.4 | 7.0 | Sl, | 3994.4 | 7.5 | Sl, |
| | 3957.4 | 7.5 | Sl, | 3999.4 | 7.8 | Sl, |
| *185905* V Aquilae—Continued. | | | | | | |
| | 3961.4 | 7.7 | Sl, | 4003.4 | 7.9 | Sl, |
| | 3971.5 | 7.5 | Sl. | 4005.4 | 7.8 | Sl. |
| | 3974.4 | 7.4 | Sl, | | | |
| 190108 R Aquilae— | | | | | | |
| | 3990.7 | 10.6 | B, | 4000.7 | 11.4 | Ca, |
| | 3992.6 | 11.3 | Pt, | 4000.8 | 11.0 | M, |
| | 3988.7 | 11.3 | Mi, | 4032.7 | 11.9 | Ca. |
| | 3999.8 | 11.1 | Mi, | | | |
| 190529a V Lyrae— | | | | | | |
| | 3992.7 | 12.0 | Pt, | 4025.7 | 12.6 | Pt, |
| | 4002.7 | 12.0 | Br, | 4035.7 | 12.8 | Ie. |
| | 4024.7 | 12.3 | Br, | | | |
| *190818* RX Sagittarii— | | | | | | |
| | 4001.1 | 11.6 | Ch, | 4003.6 | 13.3 | B. |
| *190819* RW Sagittarii— | | | | | | |
| | 3970.2 | 10.0 | Ch, | 4001.1 | 9.5 | Ch, |
| | 3992.7 | 9.1 | Pt, | 4003.6 | 9.0 | B, |
| | 3993.2 | 9.6 | Ch, | 4025.7 | 9.0 | Pt. |
| | 3994.6 | 9.2 | O, | | | |
| *190907* TY Aquarii— | | | | | | |
| | 3992.7 | 10.1 | Pt, | 4025.7 | 10.6 | Pt, |
| | 3993.7 | 10.5 | Kl, | 4032.6 | 10.2 | Kl, |
| | 4015.6 | 10.5 | Ca, | 4033.6 | 10.2 | Ca. |
| 190925 S Lyrae— | | | | | | |
| | 4015.7 | 12.9 | M. | | | |
| 190926 X Lyrae— | | | | | | |
| | 3992.7 | 9.0 | Pt, | 4025.7 | 9.0 | Pt. |
| 190933 RS Lyrae— | | | | | | |
| | 3977.2 | 11.4 | Ch, | 4004.8 | 11.7 | Lv, |
| | 3987.7 | 11.3 | Lv, | 4024.7 | 13.0 | Br, |
| | 3992.7 | 11.4 | Pt, | 4025.7 | 13.3 | Pt. |
| 190941 RU Lyrae— | | | | | | |
| | 3991.8 | 14.0 | Pa, | 4024.7 | 13.5 | Br. |
| | 3997.8 | 13.5 | Pa, | | | |
| 190967 U Draconis— | | | | | | |
| | 3986.9 | 11.8 | Br, | 4025.7 | 9.7 | Pt, |
| | 3992.7 | 11.1 | Pt, | 4031.7 | 9.7 | Br. |
| | 4015.6 | 9.9 | M, | | | |
| *191007* W Aquarii— | | | | | | |
| | 3988.1 | 10.1 | Ch, | 4025.7 | 10.5 | Pt, |
| | 3992.7 | 9.7 | Pt, | 4032.6 | 10.5 | Kl, |
| | 3993.6 | 10.1 | Kl, | 4032.7 | 10.9 | Br, |
| | 4015.6 | 10.1 | Ca, | 4033.6 | 10.5 | Ca. |
| *191017* T Sagittarii— | | | | | | |
| | 3970.2 | 8.0 | Ch, | 4000.6 | 8.6 | Ya, |
| | 3992.7 | 8.5 | Pt, | 4025.7 | 7.9 | Pt. |
| | 3993.2 | 8.2 | Ch, | | | |
| *191019* R Sagittarii— | | | | | | |
| | 3970.2 | 9.8 | Ch, | 4005.6 | 7.0 | Ca, |
| | 3988.6 | 8.6 | Mi, | 4010.7 | 7.0 | Mi, |
| | 3990.7 | 8.5 | Ca, | 4015.5 | 7.0 | Ca, |
| | 3990.7 | 8.5 | Mi, | 4019.6 | 6.6 | Ca. |
| | 3991.8 | 8.2 | Sg, | 4024.6 | 6.6 | Ca, |
| | 3992.7 | 7.9 | Pt, | 4025.7 | 6.4 | Pt, |
| | 3993.2 | 8.0 | Ch, | 4026.7 | 7.2 | Mi, |
| | 3993.6 | 8.1 | O, | 4032.6 | 6.7 | Ca, |
| | 3994.6 | 8.1 | Ya, | 4039.6 | 7.0 | Mi, |
| | 3996.7 | 8.0 | Mi, | 4043.5 | 6.9 | Ca. |
| | 4000.6 | 7.4 | Ca, | | | |

VARIABLE STAR OBSERVATIONS, July 20 to September 20, 1924—Continued.

| Star | J.D. | Est. | Obs. | J.D. | Est. | Obs. |
|---|---|---|---|---|---|---|
| *191033* RY SAGITTARII— | | | | | | |
| | 3970.2 | 9.2 | Ch, | 4012.6 | 8.1 | Pt, |
| | 3987.4 | 9.1 | L. | 4015.7 | 8.3 | Pt, |
| | 3989.6 | 9.4 | Pt, | 4017.5 | 8.5 | L, |
| | 3990.6 | 9.4 | Pt, | 4019.7 | 8.5 | Pt, |
| | 3992.1 | 9.1 | Ch, | 4023.6 | 8.4 | Pt, |
| | 3992.7 | 9.4 | Pt, | 4025.6 | 8.4 | Pt, |
| | 3993.8 | 9.5 | Pt, | 4027.6 | 8.4 | Pt, |
| | 3996.6 | 9.3 | Pt, | 4028.1 | 8.9 | Ch, |
| | 3997.6 | 9.0 | Pt, | 4028.4 | 8.3 | L, |
| | 4000.6 | 8.8 | Pt, | 4028.6 | 8.3 | Pt, |
| | 4001.1 | 9.0 | Ch, | 4031.6 | 8.0 | Pt, |
| | 4001.6 | 8.5 | Pt, | 4032.6 | 7.9 | Pt, |
| | 4003.6 | 9.0 | Pt, | 4034.6 | 8.0 | Pt, |
| | 4005.6 | 8.8 | Pt, | 4038.6 | 8.0 | Pt, |
| | 4008.6 | 8.9 | Pt, | 4046.7 | 7.9 | Pt. |
| *191319* S SAGITTARII— | | | | | | |
| | 4025.6 | 12.6 | Pt, | 4032.6 | 12.4 | Ca. |
| 191350 TZ CYGNI— | | | | | | |
| | 3992.7 | 10.6 | Pt, | 4025.6 | 10.6 | Pt, |
| | 4002.9 | 11.2 | Mi, | 4026.7 | 10.8 | Mi. |
| | 4004.8 | 11.3 | Mi, | | | |
| 191637 U LYRAE— | | | | | | |
| | 3992.7 | 10.2 | Pt, | 4025.6 | 10.7 | Pt. |
| | 3999.8 | 10.8 | M, | | | |
| 191717 T SAGITTAE— | | | | | | |
| | 4003.4 | 9.3 | Sl. | | | |
| 192928 TY CYGNI— | | | | | | |
| | 3986.6 | 11.0 | O, | 4000.8 | 10.7 | M, |
| | 4000.1 | 11.1 | Ch, | 4025.6 | 10.6 | Pt. |
| 193311 RT AQUILAE— | | | | | | |
| | 3991.6 | 10.3 | B, | 4001.6 | 10.9 | O, |
| | 3992.7 | 10.6 | Pt, | 4023.7 | 11.6 | Br, |
| | 3994.1 | 10.8 | Ch, | 4025.6 | 12.0 | Pt. |
| | 4001.1 | 10.9 | Ch, | | | |
| 193449 R CYGNI— | | | | | | |
| | 3971.1 | 11.0 | Ch, | 4010.8 | 8.2 | Mi, |
| | 3983.7 | 9.8 | Hr, | 4011.6 | 8.1 | Mi, |
| | 3983.7 | 9.8 | Cy, | 4013.6 | 7.9 | B, |
| | 3984.8 | 9.6 | Sg, | 4016.1 | 8.0 | Ch, |
| | 3986.6 | 9.7 | Mi, | 4016.7 | 8.6 | Ly, |
| | 3988.6 | 9.6 | Mi, | 4019.6 | 7.8 | B, |
| | 3990.6 | 9.4 | Mi, | 4019.6 | 8.0 | Al, |
| | 3990.6 | 9.0 | B, | 4022.6 | 8.3 | Cy, |
| | 3991.1 | 8.9 | Ch, | 4022.6 | 8.2 | Hr, |
| | 3992.7 | 8.5 | Pt, | 4024.6 | 6.8 | Kl, |
| | 3992.7 | 9.3 | Al, | 4024.6 | 8.4 | Ly, |
| | 3992.7 | 9.0 | Gb, | 4024.7 | 7.9 | Ca, |
| | 3992.7 | 9.4 | Lv, | 4024.8 | 8.0 | Gb, |
| | 3993.6 | 10.4 | Ly, | 4025.6 | 7.6 | Pt, |
| | 3993.7 | 9.1 | Cv, | 4026.7 | 7.8 | Js, |
| | 3993.7 | 9.1 | Hr, | 4027.6 | 8.1 | Mi, |
| | 3994.6 | 8.9 | Cm, | 4028.6 | 8.0 | Ly, |
| | 3996.7 | 8.7 | Lv, | 4032.7 | 8.2 | Cy, |
| | 3996.8 | 9.4 | Mi, | 4032.7 | 8.2 | Hr, |
| | 3998.6 | 8.2 | B, | 4032.7 | 7.7 | Js. |
| | 3999.6 | 8.9 | Ly, | 4034.8 | 7.8 | Gb, |
| | 3999.8 | 9.5 | M, | 4035.6 | 8.0 | Ie. |
| | 4000.1 | 8.6 | Ch, | 4036.5 | 8.5 | Pi, |
| | 4000.6 | 8.8 | Cm, | 4036.8 | 7.7 | Ca, |
| 193449 R CYGNI—Continued. | | | | | | |
| | 4000.8 | 9.1 | Mi, | 4046.6 | 8.7 | Ly, |
| | 4004.8 | 8.9 | Lv, | 4047.6 | 8.2 | Al, |
| | 4005.7 | 7.2 | Kl, | 4048.7 | 7.9 | Ca. |
| 193509 RV AQUILAE— | | | | | | |
| | 4001.6 | 12.0 | O, | 4025.6 | 10.1 | Pt. |
| 194048 RT CYGNI— | | | | | | |
| | 3983.7 | 9.9 | Hr, | 4019.6 | 8.1 | B, |
| | 3983.7 | 10.5 | Cy, | 4024.6 | 7.8 | Kl, |
| | 3984.8 | 9.8 | Sg, | 4024.7 | 8.1 | Ca, |
| | 3986.6 | 9.8 | Mi, | 4024.7 | 8.3 | Cy, |
| | 3988.6 | 9.7 | Mi, | 4024.8 | 8.1 | Gb, |
| | 3990.6 | 9.6 | B, | 4025.6 | 7.8 | Pt, |
| | 3992.7 | 9.6 | Pt, | 4025.8 | 8.1 | Mi, |
| | 3994.1 | 9.8 | Ch, | 4027.6 | 7.2 | Mi, |
| | 3999.8 | 9.7 | M, | 4030.7 | 7.8 | Js, |
| | 4000.1 | 9.3 | Ch, | 4030.7 | 7.7 | Ca, |
| | 4000.8 | 9.3 | Mi, | 4032.6 | 7.7 | Js, |
| | 4003.6 | 9.0 | B, | 4036.5 | 7.8 | Pi, |
| | 4005.7 | 9.0 | Kl, | 4036.8 | 7.5 | Ca, |
| | 4012.6 | 9.1 | Mi, | 4047.6 | 8.0 | Al, |
| | 4012.8 | 8.7 | Ca, | 4048.7 | 7.7 | Ca, |
| | 4016.1 | 8.3 | Ch, | 4048.7 | 8.2 | Hr. |
| | 4019.6 | 8.4 | Al, | | | |
| 194348 TU CYGNI— | | | | | | |
| | 3971.1 | 11.6 | Ch, | 4003.6 | 13.1 | B, |
| | 3992.7 | 13.3 | Pt, | 4003.7 | 13.0 | Br. |
| | 3994.8 | 13.7 | Lv, | | | |
| 194604 X AQUILAE— | | | | | | |
| | 3987.7 | 14.6 | Wf, | 4020.7 | 15.0 | Wf, |
| | 3991.7 | 14.8 | Wf, | 4025.7 | 14.9 | Wf, |
| | 3995.7 | 14.8 | Wf, | 4039.7 | 15.0 | Wf, |
| | 4002.7 | 14.8 | Wf, | | | |
| 194632 $\chi$ CYGNI— | | | | | | |
| | 3992.7 | 13.3 | Pt, | 4006.7 | 12.6 | Br, |
| | 4006.6 | 12.9 | B, | 4025.6 | 11.4 | Pt. |
| 195202 RR AQUILAE— | | | | | | |
| | 3986.6 | 9.5 | B, | 4025.6 | 10.3 | Pt, |
| | 3992.7 | 9.8 | Pt, | 4029.7 | 10.3 | Br. |
| 195308 RS AQUILAE— | | | | | | |
| | 4029.7 | 14.5 | Br. | | | |
| 195553 NOVA CYGNI #3— | | | | | | |
| | 3987.5 | 11.4 | Ro, | 4016.6 | 11.8 | B, |
| | 3987.6 | 11.2 | Pt, | 4019.7 | 11.5 | Pt, |
| | 3990.6 | 11.3 | Pt, | 4024.6 | 12.0 | Kl, |
| | 3992.7 | 11.4 | Pt, | 4025.6 | 11.9 | Ie, |
| | 3995.6 | 11.5 | Pt, | 4025.6 | 11.8 | Pt, |
| | 3997.6 | 11.5 | Pt, | 4027.6 | 11.7 | Pt, |
| | 4003.6 | 11.4 | Pt, | 4031.6 | 11.8 | Pt, |
| | 4005.6 | 11.4 | Pt, | 4032.8 | 11.7 | Ca, |
| | 4005.7 | 12.0 | Kl, | 4046.7 | 11.7 | Pt. |
| 195849 Z CYGNI— | | | | | | |
| | 3971.2 | 8.2 | Ch, | 4007.7 | 10.5 | Br, |
| | 3987.7 | 10.0 | Wf, | 4021.7 | 10.1 | Wf, |
| | 3994.1 | 10.2 | Ch, | 4025.6 | 9.8 | Pt, |
| | 3995.6 | 10.1 | Pt, | 4025.7 | 10.2 | Wf, |
| | 3995.6 | 9.5 | B, | 4027.8 | 10.2 | Mi, |
| | 3995.7 | 9.6 | Wf, | 4032.7 | 10.2 | Wf, |
| | 4000.8 | 9.8 | M, | 4036.5 | 11.0 | Pi, |

VARIABLE STAR OBSERVATIONS, July 20 to September 20, 1924—Continued.

| Star | J.D. | Est.Obs. | J.D. | Est.Obs. |
|---|---|---|---|---|
| | 4002.7 | 9.7 Wf, | 4037.6 | 10.4 Ie. |
| | 4003.8 | 10.1 Mi, | | |
| 200212 SY AQUILAE— | | | | |
| | 3995.6 | 12.5 Pt, | 4025.6 | 13.2 Pt. |
| | 4000.6 | 13.4 B, | | |
| 200357 S AQUILAE— | | | | |
| | 3991.8 | 14.2 Pa, | 4025.6 | 12.5 Pt, |
| | 3998 8 | 13.8 Pa, | 4035.6 | 12.6 Ie, |
| | 4020.7 | 13.8 Br, | 4039.7 | 12.7 Br. |
| 200514 R CAPRICORNI— | | | | |
| | 3988.8 | 12.4 Lv, | 4004.7 | 13.0 Lv, |
| | 3994.8 | 12.4 Lv, | 4019.6 | 12.5 B. |
| | 3995.7 | 12.3 B, | | |
| 200715a S AQUILAE— | | | | |
| | 3995.6 | 9.8 B, | 4001.6 | 9.8 O, |
| | 3998 6 | 9.8 Ya, | 4027.6 | 9.5 Pt. |
| 200715b RW AQUILAE— | | | | |
| | 3995.6 | 9.5 Pt, | 4000.8 | 10.0 M, |
| | 3995.6 | 9.2 B, | 4001.6 | 9.1 O, |
| | 3998.6 | 9.3 Ya, | 4027.6 | 9.0 Pt. |
| 200813 RU AQUILAE— | | | | |
| | 3990.7 | 12.1 Br, | 4001.6 | 11.4 O, |
| | 3992 8 | 11.8 Lv, | 4004.8 | 11.1 Lv. |
| | 3999.6 | 11.7 B, | | |
| 200906 Z AQUILAE— | | | | |
| | 3995.6 | 12.5 Pt, | 4027.7 | 12.5 Br, |
| | 4027.6 | 13.1 Pt, | 4035.7 | 12.0 Br. |
| 200916 R SAGITTAE— | | | | |
| | 3998.6 | 9.1 Ya. | | |
| 200938 RS CYGNI— | | | | |
| | 3971.2 | 8.2 Ch, | 4016.6 | 8.8 Ly, |
| | 3983.7 | 8.2 Cy, | 4016 7 | 7.9 Al, |
| | 3984.8 | 8.6 Sg, | 4016.7 | 8.8 Cy, |
| | 3986.6 | 8.3 Cy, | 4019.6 | 8.2 Al, |
| | 3988.2 | 8.6 Ch, | 4022 6 | 8.5 Ch, |
| | 3988.6 | 7.4 Js, | 4022.6 | 8 5 Hr, |
| | 3990.7 | 8.4 Ly, | 4024.6 | 8.8 Ly, |
| | 3990.7 | 8.3 Cy, | 4024.8 | 8.5 M, |
| | 3992.7 | 7.9 Al, | 4026.7 | 8.6 Js, |
| | 3993.6 | 8.2 Ly, | 4027 6 | 7.5 Pt. |
| | 3994.1 | 8.7 Ch, | 4027.7 | 9.0 Cy, |
| | 3994.6 | 7.0 Js. | 4028.6 | 8.8 Ly, |
| | 3995.6 | 7 7 Pt, | 4032.7 | 8.6 Hr, |
| | 3996.7 | 8.7 Ly, | 4032 7 | 8.7 Cy, |
| | 3999.6 | 7.1 Js, | 4033.7 | 9.0 Js. |
| | 4000.1 | 8.7 Ch, | 4047.7 | 8.6 Al. |
| 201008 R DELPHINI— | | | | |
| | 3995.6 | 13.1 Pt, | 4020.6 | 11.6 Ie, |
| | 3996.7 | 12 6 Br, | 4025.6 | 11.6 Mi, |
| | 3999.7 | 12.1 B, | 4027.6 | 11.4 Pt. |
| | 4001.6 | 12.2 Ie, | | |
| 201121 RT CAPRICORNI— | | | | |
| | 3988.0 | 7.6 Kd, | 4021.0 | 7.5 Kd. |
| | 4000.0 | 7.3 Kd, | | |
| 201130 SX CYGNI— | | | | |
| | 3995.6 | 9 6 Pt, | 4027.6 | 10.3 Pt, |
| | 3995.7 | 9.3 B, | 4029.7 | 10.4 Br. |
| 201130 RT SAGITTARII— | | | | |
| | 4027.6 | 6.9 Pt. | | |
| 201437 WX CYGNI— | | | | |
| | 3983.7 | 11.4 Cy, | 4013.6 | 10.5 B, |
| | 3984.8 | 11.5 Sg, | 4022.6 | 10.6 Cy, |
| | 3986.6 | 11.4 Cy, | 4024.6 | 10.9 Ly, |
| | 3989.7 | 11.2 Lv, | 4024.6 | 10.8 Kl, |
| | 3990.6 | 10.5 B, | 4024.7 | 10.5 Cy, |
| | 3990.7 | 10.8 Cy, | 4024.8 | 11.0 M, |
| | 3995.6 | 11.4 Pt, | 4027.6 | 10.4 Pt, |
| | 3997.8 | 11.0 Br, | 4027.7 | 11.0 Cy, |
| | 4003.8 | 11.1 Mi, | 4028.6 | 10.8 Ly, |
| | 4005.7 | 10.9 Kl, | 4029.6 | 11.3 Mi, |
| | 4005.7 | 11.3 Lv, | 4032.7 | 11.1 Cy, |
| | 4006.6 | 10.5 B. | 4035.5 | 10.6 Ie. |
| 201647 U CYGNI— | | | | |
| | 3984.6 | 9.1 Mi, | 4002.5 | 7.8 Ro, |
| | 3984 8 | 8.6 Sg, | 4006.5 | 7.8 Ro, |
| | 3987.5 | 8.0 Ro, | 4012.5 | 7.7 Ca, |
| | 3988.1 | 9.2 Ch, | 4012.8 | 7.9 Mi, |
| | 3988.6 | 8.1 Ca, | 4015.5 | 7.6 Ro, |
| | 3991.6 | 8.4 B, | 4024.7 | 7.7 Ca, |
| | 3995.6 | 8.2 Pt, | 4026.7 | 7.8 Js, |
| | 3996.8 | 9.2 Mi, | 4027.6 | 7.7 Pt, |
| | 3999.6 | 7.7 Js, | 4030.7 | 7.7 Ca, |
| | 4000 6 | 8.0 Ca, | 4033.7 | 7.7 Js, |
| | 4000.8 | 9.0 M, | 4036.5 | 8.0 Pi, |
| | 4001.5 | 7.9 Ro, | 4036.8 | 7.6 Ca. |
| | 4001.6 | 9.0 Mi, | | |
| 202539 RW CYGNI— | | | | |
| | 4024.8 | 8.5 M. | | |
| 202622 RU CAPRICORNI— | | | | |
| | 3991.6 | 11.9 B. | | |
| 202817 Z DELPHINI— | | | | |
| | 3989.8 | 12.6 Lv, | 4013.7 | 12.0 Br, |
| | 3999 7 | 12.7 B, | 4027.6 | 11.2 Pt. |
| | 4005.7 | 12.3 Lv, | 4028.6 | 11.2 Mi. |
| 202946 SZ CYGNI— | | | | |
| | 3987.6 | 9.4 Pt, | 4015.7 | 9.0 Pt, |
| | 3988.6 | 9.5 Pt, | 4019.7 | 9.6 Pt, |
| | 3989.6 | 9 2 Pt, | 4021.6 | 9.8 Pt, |
| | 3990.6 | 9.6 Pt, | 4023.6 | 9.5 Pt, |
| | 3992.7 | 9.5 Pt, | 4024.6 | 9.4 Pt, |
| | 3995.6 | 9.1 Pt, | 4026.8 | 8.8 Pt, |
| | 3996.6 | 9 0 Pt, | 4027.6 | 8.9 Pt, |
| | 3997.6 | 9.1 Pt, | 4029.6 | 8.9 Pt, |
| | 3999 6 | 9.2 Pt, | 4031.6 | 9.4 Pt, |
| | 4000.6 | 9.2 Pt, | 4032.6 | 9.4 Pt, |
| | 4001.6 | 9 4 Pt, | 4034.6 | 9.4 Pt, |
| | 4003.6 | 9.1 Pt, | 4038.6 | 9.5 Pt, |
| | 4005.6 | 9.8 Pt, | 4042.7 | 8.8 Pt. |
| | 4008.6 | 9.6 Pt, | 4043.7 | 8.8 Pt, |
| | 4010.6 | 8 8 Pt, | 4046.7 | 8.9 Pt. |
| | 4011.6 | 8.8 Pt, | | |
| 202954 ST CYGNI— | | | | |
| | 3995.6 | 13.2 Pt, | 4027.6 | 12.5 Pt, |
| | 3997.7 | 13.5 Br, | 4035.6 | 12.3 Ie, |
| | 4000.6 | 13.6 B, | 4036.5 | 12.8 Pi, |
| | 4019.6 | 12.8 B; | 4039.7 | 12.4 Br. |
| | 4021.7 | 13.2 Br, | | |
| 203226 V VULPECULAE— | | | | |
| | 3995.6 | 8.6 Pt. | 4027.6 | 8.7 Pt. |

VARIABLE STAR OBSERVATIONS, July 20 to September 20, 1924—Continued.

| Star | J.D. | Est. | Obs. | J.D. | Est. | Obs. |
|---|---|---|---|---|---|---|
| 203611 Y DELPHINI— | | | | | | |
| | 3986.6 | 10.6 | O, | 4024.6 | 11.9 | B, |
| | 3995.6 | 10.7 | B, | 4027.6 | 11.6 | Pt, |
| | 3995.6 | 10.8 | Pt, | 4034.6 | 12.0 | Kl, |
| | 4013.7 | 11.5 | Br, | 4039.7 | 12.0 | Br. |
| | 4014.6 | 11.4 | Kl, | | | |
| 203816 S DELPHINI— | | | | | | |
| | 3985.6 | 9.6 | O, | 4000.8 | 10.8 | M, |
| | 3995.6 | 10.0 | Pt, | 4024.6 | 11.4 | B, |
| | 3998.6 | 10.4 | B, | 4027.6 | 11.6 | Pt. |
| 203847 V CYGNI— | | | | | | |
| | 3990.7 | 11.9 | Br, | 4020.7 | 11.2 | Br, |
| | 3995 6 | 10.3 | Pt, | 4028.1 | 11.0 | Ch, |
| | 3995.7 | 9.8 | B, | 4028.6 | 10.0 | Pt. |
| | 4000.1 | 11.8 | Ch, | | | |
| 203905 Y AQUARII— | | | | | | |
| | 3995.7 | 12.0 | Pt, | 4028.6 | 9.7 | Pt, |
| | 4019.7 | 9.8 | Ie, | 4033.7 | 10.4 | Cy. |
| | 4027.7 | 10.6 | Br, | | | |
| 204016 T DELPHINI— | | | | | | |
| | 3984.8 | 12.2 | Pa, | 4013.7 | 10.8 | Br, |
| | 3989.8 | 12.4 | Wf, | 4018.7 | 10.4 | Wf, |
| | 3990.7 | 11.0 | Mi, | 4022.6 | 9.9 | Ie, |
| | 3995.7 | 12.3 | Pt, | 4024.6 | 9.7 | B. |
| | 3995.7 | 12.2 | Wf, | 4024.7 | 10.2 | Wf, |
| | 3999.6 | 11.9 | B, | 4025.9 | 9.6 | Mi, |
| | 3999 6 | 11.9 | Mi, | 4028.6 | 9.4 | Pt. |
| | 4000.7 | 12.0 | Mi, | 4029.7 | 9.6 | Wf, |
| | 4000.8 | 11.0 | M, | 4033.6 | 9.6 | Cy, |
| | 4002.8 | 11.7 | Wf, | 4036.6 | 9.6 | O. |
| | 4006.6 | 11.3 | Ie, | | | |
| *204102* V AQUARII— | | | | | | |
| | 3995.7 | 7.3 | Pt, | 4028.6 | 8.9 | Mi, |
| | 4000.6 | 8.0 | Ya, | 4028.6 | 8.3 | Pt. |
| | 4016.6 | 8.3 | B, | | | |
| *204104* W AQUARII— | | | | | | |
| | 4000.6 | 11.5 | Ya, | 4027.7 | 13.6 | Br. |
| | 4017.4 | 12.9 | L, | | | |
| *204215* U CAPRICORNI— | | | | | | |
| | 4000.7 | 14.0 | B. | | | |
| 204318 V DELPHINI— | | | | | | |
| | 3991.8 | 14.9 | Pa, | 3998.8 | 14.0 | Pa. |
| | 3997.8 | 14.0 | Pa, | | | |
| *204405* T AQUARII— | | | | | | |
| | 3988 6 | 7.5 | Ca, | 4019.7 | 8.9 | Ly, |
| | 3990.8 | 7.8 | Mi, | 4024.6 | 9.3 | Ly, |
| | 3995.7 | 7.6 | Pt, | 4026.2 | 9.6 | Ch, |
| | 3999.6 | 7.8 | Js, | 4026.6 | 9.4 | Mi, |
| | 3999.6 | 7.5 | Ca, | 4027.7 | 10.0 | Br, |
| | 3999.7 | 8.0 | Mi, | 4028.6 | 9.4 | Pt, |
| | 4000.6 | 7.8 | Ya, | 4028.6 | 9.5 | Js, |
| | 4015.6 | 8.7 | Ca, | 4033.7 | 10.5 | Ca, |
| | 4019 6 | 9.0 | Js, | 4039.7 | 10.7 | Br, |
| | 4019.6 | 8.7 | Ca, | 4046.6 | 9.8 | Lv. |
| 204846 RZ CYGNI— | | | | | | |
| | 3989.8 | 13.6 | Wf, | 4019.6 | 11.2 | B, |
| | 3990.7 | 14.0 | Br, | 4021.7 | 11.8 | Br, |
| | 3995 7 | 13.5 | Wf, | 4021.7 | 11.8 | Wf, |
| | 3995.7 | 13.5 | Pt, | 4028.6 | 11.9 | Pt, |
| 204846 RZ CYGNI—Continued. | | | | | | |
| | 4000.6 | 12.7 | B, | 4029.7 | 11.1 | Wf, |
| | 4002.8 | 13.2 | Wf, | 4035.6 | 11.0 | Ie. |
| 205017 X DELPHINI— | | | | | | |
| | 3992.8 | 13.6 | Lv, | 4005.7 | 13.6 | Lv, |
| | 4003.6 | 13.6 | B, | 4029.7 | 13.4 | Br. |
| 205923 R VULPECULAE— | | | | | | |
| | 3991.6 | 8.5 | O, | 4016.6 | 8.1 | B, |
| | 3994.9 | 8.0 | Lv, | 4024 6 | 9.0 | Ie, |
| | 3995.7 | 8.0 | Pt, | 4028.6 | 8.4 | Pt, |
| | 3996.6 | 7.7 | Ca, | 4029.6 | 9.1 | Mi, |
| | 4005.6 | 7.6 | Ca, | 4030.6 | 9.5 | Js, |
| | 4005.7 | 8.0 | Lv, | 4035.7 | 9.8 | Js. |
| | 4007.7 | 7.8 | Br, | | | |
| 210129 TW CYGNI— | | | | | | |
| | 4000.6 | 12.8 | B, | 4019.7 | 12.8 | Br, |
| | 4001.6 | 13.4 | Ie, | 4022.6 | 12.9 | Ie. |
| | 4019.6 | 12.8 | B, | | | |
| 210382 X CEPHEI— | | | | | | |
| | 3977.8 | 14.6 | Pa, | 3998 8 | 11.3 | Pa, |
| | 3991.8 | 12.7 | Pa, | 4007.8 | 10.9 | Br, |
| *210504* RS AQUARII— | | | | | | |
| | 3995.7 | 13.4 | Pt, | 4028.6 | 13.8 | |
| | 4028.4 | 13.3 | L, | 4029.7 | 13.5 | Br. |
| *210516* Z CAPRICORNI— | | | | | | |
| | 4019.7 | 10.6 | B, | 4028.7 | 10.6 | Mi. |
| | 4028.6 | 10 9 | Pt, | | | |
| 210812 R EQUULEI— | | | | | | |
| | 3986.6 | 11.5 | O, | 4014.7 | 13.2 | Br, |
| | 3989.8 | 12.0 | Wf, | 4021.7 | 12.4 | Wf, |
| | 3995.7 | 12.5 | Wf, | 4028.6 | 13.8 | Pt, |
| | 3995.7 | 12.4 | Pt, | 4029.7 | 13.7 | Wf, |
| | 4002.8 | 12.6 | Wf, | 4029.7 | 13.7 | Br. |
| 210868 T CEPHEI— | | | | | | |
| | 3985.6 | 6.1 | Js, | 4016.6 | 6.7 | Al, |
| | 3985.6 | 6.3 | Sg, | 4016.7 | 7.5 | I, |
| | 3987.6 | 6.7 | I, | 4019.6 | 7.8 | Js, |
| | 3988.6 | 6.5 | Ca, | 4020.6 | 7.9 | I, |
| | 3990.6 | 6.8 | I, | 4027 7 | 7.0 | Js, |
| | 3992.2 | 6.7 | Ch, | 4028.6 | 7.4 | Pt, |
| | 3992.7 | 6.7 | Al, | 4028.7 | 8.0 | Mi, |
| | 3993.7 | 6.0 | Js, | 4028.8 | 7.8 | M, |
| | 3995.6 | 6.8 | I, | 4029.4 | 7.2 | L, |
| | 3995.7 | 6.5 | Pt, | 4030.2 | 8.0 | Ch, |
| | 3996.6 | 6.5 | Ca, | 4031.6 | 7.6 | Kl, |
| | 3999.6 | 6.9 | I. | 4033.5 | 7.0 | Ca, |
| | 4005.6 | 6.8 | Ca, | 4033.7 | 7.5 | Js, |
| | 4005.7 | 6.1 | Kl, | 4038.6 | 8.1 | Mi, |
| | 4007.8 | 7.7 | M, | 4038.7 | 7.9 | Al. |
| | 4012.6 | 6.8 | Ca, | | | |
| *210903* RR AQUARII— | | | | | | |
| | 3997.6 | 11.5 | Pt, | 4029.7 | 9.7 | Br. |
| | 4028.6 | 9.4 | Pt, | | | |
| 211614 X PEGASI— | | | | | | |
| | 3988.6 | 9.5 | O, | 4028.6 | 11.3 | Pt, |
| | 3997.6 | 7.6 | Pt, | 4032.7 | 11.3 | Br. |
| | 4021.7 | 10.8 | Br, | | | |

PLATE XXXII.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65

MEETING OF THE AMERICAN ASSOCIATION OF VARIABLE STAR OBSERVERS AT HARVARD COLLEGE OBSERVATORY, OCTOBER 11, 1924.

## Key to Plate XXXII.

1 King
2 Mrs. Sawyer
4 Miss Hodgdon
5 Campbell
6 Brigham
7 Mrs. M. F. Jordan
8 Mrs. Elmer
9 Butler
10 Miss Farnsworth
11 Tarwater
12 Godfrey
13 Cudworth
14 Sawyer
15 Miss Godfrey
16 Cilley
17 Miss Estabrook
18 Miss Estabrook
19 Le Maitre
20 Miss Woods
21 Miss Gill
22 Suter
23 Miss Cushman
24 Prentice
25 Henry
26 Miss Partridge
27 Miss Swartz
28 Mrs. Morris
29 Whittier
30 Kearons
31 Shapley
32 Miss Maury
33 Olcott
34 Mrs. Farnham
35 Yalden
36 Mrs. Holmes
37 Mrs. Kearons
38 Miss Harwood
39 Miss Leland
40 M. J. Jordan
41 Miss Young
42 Miss Cannon
43 Whitehorn
44 Allen
45 Miss Payne
46 Brown
47 Potter
48 Mrs. Jewett
49 Jewett
50 Mowry
51 Miss Potter
52 Poss
53 M. F. Jordan
54 Mrs. Boss
55 Elmer
56 Fisher
57 Stetson
58 Murray
59 Mayall
60 Reardon
61 Jones
62 Miss Clough
63 Fox
64 Farnham
65 Mrs. Rogers

VARIABLE STAR OBSERVATIONS, July 20 to September 20, 1924—Continued.

| Star | J.D. | Est. | Obs. | J.D. | Est. | Obs. |
|---|---|---|---|---|---|---|
| 213244 W CYGNI— | | | | | | |
| | 3931.0 | 6.0 | Kd, | 3986.0 | 6.2 | Kd, |
| | 3936.3 | 6.0 | Kd, | 3989.0 | 6.3 | Kd, |
| | 3936.4 | 6.2 | An, | 3992.4 | 6.5 | An, |
| | 3956.0 | 6.2 | Kd, | 3995.0 | 6.2 | Kd, |
| | 3957.3 | 6.1 | Kd, | 4000.0 | 6.2 | Kd, |
| | 3958.4 | 6.2 | An, | 4000.4 | 6.5 | An, |
| | 3964.4 | 6.5 | An, | 4005.0 | 6.2 | Kd, |
| | 3969.4 | 6.4 | An, | 4008.0 | 6.3 | Kd, |
| | 3975.0 | 6.2 | Kd, | 4012.3 | 6.4 | An, |
| | 3987.0 | 6.2 | Kd, | 4021.0 | 6.3 | Kd, |
| | 3987.4 | 6.4 | An, | 4028.4 | 6.5 | An. |
| 213678 S CEPHEI— | | | | | | |
| | 3993.6 | 10.3 | Mi, | 4028.6 | 8.4 | Pt, |
| | 3996.8 | 10.2 | Mi, | 4029.7 | 10.1 | Br, |
| | 3997.6 | 8.9 | Pt, | 4031.2 | 10.0 | Ch, |
| | 4000.7 | 10.2 | Mi, | 4031.6 | 10.0 | Kl, |
| | 4005.7 | 9.9 | Kl, | 4033.7 | 10.0 | Cy, |
| | 4018.7 | 10.2 | Mi, | 4034.7 | 10.1 | Mi. |
| | 4025.7 | 10.1 | Mi, | | | |
| 213753 RU CYGNI— | | | | | | |
| | 3997.6 | 9.0 | Pt, | 4024.8 | 9.6 | M, |
| | 4007.8 | 9.1 | M, | 4028.6 | 9.3 | Pt. |
| 213843 SS CYGNI— | | | | | | |
| | 3921.3 | 11.6 | Nk, | 4008.6 | 11.7 | M, |
| | 3934.1 | 8.6 | Nk, | 4008.6 | 11.8 | Pt, |
| | 3956.2 | 11.2 | Nk, | 4008.7 | 11.8 | Br, |
| | 3957.2 | 11.0 | Nk, | 4008.7 | 11.6 | Wf, |
| | 3964.1 | 8.7 | Nk, | 4008.7 | 11.6 | Cy, |
| | 3971.2 | 11.3 | Ch, | 4009.6 | 11.4 | Kl, |
| | 3972.3 | 11.3 | Nk, | 4009.7 | 11.9 | Br, |
| | 3972.6 | 10.2 | Al, | 4010.6 | 11.8 | Pt, |
| | 3974.0 | 11.4 | Nk, | 4011.6 | 11.8 | Pt, |
| | 3975.1 | 11.2 | Nk, | 4012.6 | 11.6 | Ca, |
| | 3976.2 | 11.2 | Ch, | 4012.6 | 11.7 | B, |
| | 3977.2 | 11.3 | Ch, | 4012.6 | 11.8 | Pt, |
| | 3978.3 | 11.3 | Nk, | 4012.6 | 11.6 | Ie, |
| | 3978.4 | 11.3 | Ch, | 4013.6 | 11.8 | B, |
| | 3978.8 | 12.0 | Wf, | 4013.6 | 11.8 | Ie, |
| | 3979.8 | 11.6 | Wf, | 4013.7 | 11.9 | Br, |
| | 3980.7 | 11.8 | Wf, | 4014.6 | [11.0 | Gb, |
| | 3984.7 | 12.0 | Cy, | 4014.6 | 11.3 | Kl, |
| | 3984.8 | [11.3 | Sg, | 4014.7 | 11.9 | Br, |
| | 3985.6 | 11.5 | O, | 4015.5 | 11.6 | Ro, |
| | 3985.7 | 11.9 | Cy, | 4015.6 | 11.5 | Ca, |
| | 3985.7 | 11.8 | Wf, | 4015.7 | 11.7 | Pt, |
| | 3986.0 | 11.8 | Nk, | 4016.1 | [11.3 | Ch, |
| | 3986.6 | 11.5 | O, | 4016.6 | 12.0 | Pn, |
| | 3986.6 | 11.8 | Mi, | 4016.6 | 11.7 | Ie, |
| | 3986.7 | 11.8 | Wf, | 4016.6 | 10.5 | I, |
| | 3986.7 | 11.9 | Br, | 4016.7 | 11.5 | Ly, |
| | 3986.7 | 11.8 | Cy, | 4017.4 | 11.5 | L, |
| | 3987.4 | 11.8 | L, | 4018.6 | 11.9 | Mi, |
| | 3987.5 | 11.8 | Ro, | 4018.7 | 11.8 | Wf, |
| | 3987.6 | 11.8 | Pt, | 4019.5 | 11.5 | Ca, |
| | 3987.7 | 11.8 | Wf, | 4019.6 | 11.7 | B, |
| | 3988.0 | 11.8 | Nk, | 4019.6 | 11.6 | Ly, |
| | 3988.1 | [11.3 | Ch, | 4019.7 | 11.7 | Ie, |
| | 3988.6 | 11.5 | O, | 4019.7 | 11.7 | Pt, |
| | 3988.6 | 11.9 | Ca, | 4019.7 | 12.0 | Br, |
| 213843 SS CYGNI—Continued. | | | | | | |
| | 3988.6 | 11.9 | Mi, | 4020.6 | 11.6 | Ie, |
| | 3988.6 | 11.8 | Pt, | 4020.6 | 11.0 | I, |
| | 3989.6 | 11.8 | Pt, | 4020.7 | 11.7 | Br, |
| | 3989.6 | 11.7 | Kl, | 4020.7 | 11.3 | Wf, |
| | 3989.8 | 11.9 | Ca, | 4020.8 | 11.3 | Wf, |
| | 3989.8 | 11.8 | Wf, | 4021.6 | 11.6 | B, |
| | 3990.6 | 11.6 | Ca, | 4021.7 | 11.4 | Pt, |
| | 3990.6 | 12.0 | Cv, | 4021.7 | 11.0 | Br, |
| | 3990.6 | 11.0 | I, | 4021.7 | 11.5 | Wf, |
| | 3990.6 | 11.5 | O, | 4022.6 | 11.6 | Ie, |
| | 3990.6 | 11.7 | Pt, | 4022.6 | 11.6 | Cy, |
| | 3990.6 | 12.0 | Cy, | 4022.7 | 11.4 | Wf, |
| | 3990.6 | 11.9 | Mi, | 4022.7 | 10.7 | Br, |
| | 3990.7 | 11.6 | Ly, | 4023.6 | 11.5 | Pt, |
| | 3990.7 | 11.5 | Wf, | 4023.7 | 10.9 | Br, |
| | 3990.7 | 11.7 | Br, | 4023.7 | 11.5 | Wf, |
| | 3991.6 | [11.0 | O, | 4024.5 | 11.6 | Ie, |
| | 3991.7 | 11.9 | Br, | 4024.6 | 11.5 | Cy, |
| | 3991.7 | 11.8 | Wf, | 4024.6 | 11.3 | Ly, |
| | 3991.8 | 11.8 | Sg, | 4024.6 | 11.5 | Pt, |
| | 3992.2 | 12.0 | Ch, | 4024.6 | 10.8 | Kl, |
| | 3992.7 | 12.0 | Cy, | 4024.7 | 11.3 | Wf, |
| | 3992.7 | 11.8 | Wf, | 4024.7 | 11.6 | Br, |
| | 3992.7 | 11.8 | Pt, | 4024.8 | 11.6 | M, |
| | 3992.8 | 12.0 | Lv, | 4024.8 | 11.8 | Lv, |
| | 3993.6 | [11.0 | O, | 4025.5 | 11.5 | Ie, |
| | 3993.6 | 11.5 | Kl, | 4025.6 | 11.1 | Mi, |
| | 3993.7 | 11.8 | Wf, | 4025.6 | 11.1 | Kl, |
| | 3993.7 | 12.0 | Cy, | 4025.6 | 11.6 | Pt, |
| | 3993.8 | 11.7 | Pt, | 4025.7 | 11.1 | Br, |
| | 3994.1 | [11.3 | Ch, | 4025.7 | 11.0 | Wf, |
| | 3994.6 | 11.6 | M, | 4026.2 | 11.1 | Ch, |
| | 3994.6 | [10.5 | Cm, | 4026.5 | 10.2 | Ie, |
| | 3994.7 | 11.6 | Cy, | 4026.6 | 10.7 | Ly, |
| | 3994.8 | 11.6 | Wf, | 4026.6 | 10.6 | Mi, |
| | 3994.6 | 11.9 | Mi, | 4026.7 | 11.0 | Cy, |
| | 3995.6 | 11.0 | I, | 4026.7 | 10.7 | Wf, |
| | 3995.6 | 11.7 | Pt, | 4026.8 | 9.8 | Pt, |
| | 3995.7 | 11.4 | Br, | 4026.8 | 11.0 | M, |
| | 3995.7 | 11.3 | Wf, | 4027.1 | 11.0 | Ch, |
| | 3996.6 | 8.7 | Mi, | 4027.6 | 8.6 | Ie, |
| | 3996.6 | 9.0 | Ca, | 4027.6 | 8.5 | Mi, |
| | 3996.6 | 9.3 | Pt, | 4027.6 | 9.3 | Pt, |
| | 3996.6 | 8.7 | Ly, | 4027.6 | 9.0 | Cy, |
| | 3996.7 | 8.7 | Br, | 4027.6 | 8.3 | Cm, |
| | 3996.7 | 9.0 | Wf, | 4027.6 | 8.5 | Ly, |
| | 3997.1 | 8.3 | Nk, | 4027.7 | 8.6 | Br, |
| | 3997.2 | 8.4 | Ch, | 4027.8 | 9.0 | M, |
| | 3997.6 | 8.7 | Ca, | 4027.8 | 8.7 | Wf, |
| | 3997.6 | 8.5 | O, | 4028.1 | 8.4 | Ch, |
| | 3997.6 | 8.3 | Ly, | 4028.4 | 8.6 | L, |
| | 3997.6 | 9.0 | Pt, | 4028.5 | 8.6 | Ie, |
| | 3997.6 | 8.4 | Mi, | 4028.5 | 8.8 | Ro, |
| | 3997.7 | 8.6 | Br, | 4028.6 | 8.4 | Mi, |
| | 3997.8 | 8.6 | Wf, | 4028.6 | 8.3 | Ly, |
| | 3998.6 | 8.3 | Ly, | 4028.6 | 9.0 | Pt, |
| | 3998.6 | 8.8 | B, | 4028.6 | 8.4 | Cy, |
| | 3998.7 | 8.7 | Wf, | 4028.8 | 8.8 | M, |
| | 3999.6 | 8.5 | O, | 4029.4 | 8.8 | L, |

VARIABLE STAR OBSERVATIONS, July 20 to September 20, 1924—Continued.

| Star | J.D. | Est. | Obs. | J.D. | Est. | Obs. |
|---|---|---|---|---|---|---|
| 213843 SS CYGNI—Continued. | | | | | | |
| | 3999.6 | 8.4 | Mi, | 4029.5 | 8.4 | Ie, |
| | 3999.6 | 8.9 | Ca, | 4029.5 | 8.5 | Mi, |
| | 3999.6 | 9.1 | Pt, | 4029.7 | 8.5 | Wf, |
| | 3999.6 | 8.4 | I, | 4029.7 | 8.7 | Br, |
| | 3999.6 | 8.5 | Ly, | 4029.8 | 8.6 | Cy, |
| | 3999.7 | 8.7 | Wf, | 4030.5 | 8.3 | Cy, |
| | 3999.7 | 8.4 | Cm, | 4030.7 | 8.4 | Wf, |
| | 3999.7 | 8.8 | B, | 4030.7 | 8.3 | Ca, |
| | 3999.8 | 8.8 | M, | 4031.1 | 8.3 | Ch, |
| | 4000.1 | 8.4 | Ch, | 4031.6 | 8.3 | Kl, |
| | 4000.6 | 9.1 | Pt, | 4031.6 | 8.5 | Pt, |
| | 4000.6 | 9.1 | Ca, | 4031.7 | 8.5 | Br, |
| | 4000.6 | 8.9 | Kl, | 4031.8 | 8.4 | Wf, |
| | 4000.6 | 8.8 | O, | 4032.5 | 8.4 | Ie, |
| | 4000.6 | 8.7 | Ly, | 4032.6 | 8.2 | Kl, |
| | 4000.6 | 9.0 | Ie, | 4032.6 | 8.4 | Pt, |
| | 4000.8 | 9.0 | M, | 4032.7 | 8.6 | Wf, |
| | 4001.1 | 8.6 | Ch, | 4032.7 | 8.6 | Br, |
| | 4001.5 | 9.4 | Ro, | 4032.7 | 8.2 | Cy, |
| | 4001.6 | 9.6 | Pt, | 4032.8 | 8.3 | Ca, |
| | 4001.6 | 8.9 | Ly, | 4032.8 | 8.3 | M, |
| | 4001.6 | 9.6 | Mi, | 4033.5 | 8.7 | Ca, |
| | 4001.6 | 9.2 | Ie, | 4033.6 | 8.4 | Kl, |
| | 4001.6 | 9.1 | O, | 4033.6 | 8.2 | Cy, |
| | 4001.8 | 9.3 | M, | 4033.7 | 8.4 | Wf, |
| | 4002.5 | 9.6 | Ro, | 4033.7 | 8.6 | Ie, |
| | 4002.6 | 9.7 | Ie, | 4034.6 | 8.4 | Pt, |
| | 4002.7 | 9.8 | Br, | 4034.6 | 8.4 | Kl, |
| | 4002.7 | 9.8 | Wf, | 4034.7 | 8.6 | Wf, |
| | 4002.9 | 9.8 | Mi, | 4034.7 | 8.6 | Mi, |
| | 4003.6 | 10.2 | Ly, | 4034.7 | 8.3 | Br, |
| | 4003.6 | 10.3 | Mi, | 4035.5 | 8.5 | Ie, |
| | 4003.6 | 10.5 | B, | 4035.7 | 8.6 | Br, |
| | 4003.6 | 10.2 | Pt, | 4036.5 | 8.3 | Pi, |
| | 4003.7 | 10.2 | Ie, | 4036.7 | 8.8 | Wf, |
| | 4003.7 | 10.1 | Br, | 4036.8 | 8.8 | Ca, |
| | 4003.9 | 10.4 | Wf, | 4037.5 | 8.7 | Ie, |
| | 4004.6 | 10.5 | Ie, | 4037.6 | 8.4 | Kl, |
| | 4004.6 | 10.5 | Ly, | 4037.7 | 8.3 | Br, |
| | 4004.6 | 10.6 | B, | 4038.5 | 8.5 | Mi, |
| | 4004.6 | 11.2 | M, | 4038.6 | 9.1 | Pt, |
| | 4004.8 | 10.8 | Wf, | 4039.5 | 9.1 | Ie, |
| | 4004.9 | 10.9 | Mi, | 4039.6 | 8.6 | Mi, |
| | 4005.6 | 11.3 | Ca, | 4039.7 | 9.1 | Br, |
| | 4005.6 | 10.9 | Pt, | 4039.7 | 8.9 | Wf, |
| | 4005.6 | 11.2 | B, | 4040.5 | 8.9 | Mi, |
| | 4005.7 | 11.6 | Lv, | 4040.5 | 9.2 | Ie, |
| | 4005.7 | 11.0 | Kl, | 4040.7 | 9.3 | Br, |
| | 4005.8 | 11.8 | Sg, | 4040.9 | 9.4 | Wf, |
| | 4006.6 | 11.5 | Ly, | 4041.5 | 9.6 | Mi, |
| | 4006.6 | 11.7 | B, | 4041.6 | 9.8 | Kl, |
| | 4006.6 | 11.5 | Ie, | 4041.7 | 9.5 | Br, |
| | 4006.6 | 11.5 | Ca, | 4041.8 | 9.5 | Wf, |
| | 4006.7 | 11.6 | Lv, | 4042.7 | 9.8 | Pt, |
| | 4006.7 | 11.6 | Wf, | 4043.5 | 10.8 | Ca, |
| | 4006.7 | 11.7 | Br, | 4043.7 | 10.0 | Pt, |
| | 4007.6 | 11.2 | Kl, | 4045.8 | 11.3 | Kl, |
| | 4007.7 | 11.5 | Wf, | 4046.7 | 10.7 | Pt, |
| | 4007.7 | 11.8 | Br, | 4047.5 | 11.6 | Ly, |
| | 4007.8 | 12.0 | M, | 4047.6 | 11.6 | Cy, |
| | 4008.5 | 11.6 | Ie, | 4048.7 | 11.8 | Ca. |
| 213937 RV CYGNI— | | | | | | |
| | 3997.6 | 6.7 | Pt, | 4024.8 | 7.8 | M, |
| | 4007.8 | 8.3 | M, | 4028.7 | 6.7 | Pt. |
| 214024 RR PEGASI— | | | | | | |
| | 3989.8 | 13.0 | Wf, | 4019.7 | 13.3 | Br, |
| | 3995.7 | 13.2 | Wf, | 4021.7 | 13.5 | Wf, |
| | 3997.6 | 12.7 | Pt, | 4029.7 | 13.7 | Wf. |
| | 4002.8 | 13.2 | Wf, | | | |
| 215605 V PEGASI— | | | | | | |
| | 3996.7 | 9.7 | Br, | 4028.7 | 11.4 | Mi, |
| | 3997.6 | 10.0 | Pt, | 4028.7 | 11.3 | Pt, |
| | 4005.8 | 10.2 | Lv, | 4035.7 | 11.7 | Br. |
| | 4019.7 | 10.6 | Br, | | | |
| *215717* U AQUARII— | | | | | | |
| | 4000.8 | 11.1 | Pt, | 4028.7 | 11.6 | Pt. |
| 215934 RT PEGASI— | | | | | | |
| | 3987.6 | 11.1 | O, | 4000.8 | 11.1 | Pt, |
| | 3991.8 | 11.0 | Sg, | 4019.7 | 11.0 | Br, |
| | 3996.7 | 13.5 | Lv, | 4028.7 | 10.0 | Pt. |
| | 4005.7 | 13.5 | Lv, | | | |
| 220133a RY PEGASI— | | | | | | |
| | 4000.8 | 11.9 | Pt, | 4028.7 | 12.0 | Pt. |
| 220133b RZ PEGASI— | | | | | | |
| | 4000.8 | 12.0 | Pt, | 4028.7 | 12.4 | Pt, |
| | 4007.8 | 12.5 | Br, | 4029.7 | 13.0 | Br, |
| | 4021.7 | 13.0 | Br, | 4035.7 | 12.7 | Br. |
| 220412 T PEGASI— | | | | | | |
| | 3986.6 | 10.6 | O, | 4019.7 | 13.7 | Br. |
| 220613 Y PEGASI— | | | | | | |
| | 4000.8 | 11.3 | Pt, | 4019.7 | 11.4 | Br, |
| | 4005.8 | 11.0 | Lv, | 4028.7 | 12.2 | Pt. |
| 220714 RS PEGASI— | | | | | | |
| | 4000.8 | 12.3 | Pt, | 4019.7 | 12.0 | Br, |
| | 4005.8 | 12.4 | Lv, | 4028.7 | 12.2 | Pt. |
| 222129 RV PEGASI— | | | | | | |
| | 4029.8 | 13.2 | Br. | | | |
| 222439 S LACERTAE— | | | | | | |
| | 4000.8 | 12.2 | Pt, | 4022.6 | 12.9 | Ie, |
| | 4005.8 | 12.3 | Lv, | 4022.7 | 12.9 | Br, |
| | 4006.6 | 11.8 | Ie, | 4028.7 | 12.6 | Pt, |
| | 4007.8 | 12.6 | Br, | 4035.7 | 12.9 | Br. |
| 225914 TW PEGASI— | | | | | | |
| | 3987.6 | 10.2 | O, | 4016.8 | 10.4 | M, |
| | 3991.8 | 9.6 | Sg, | 4026.8 | 10.6 | M, |
| | 4000.8 | 9.6 | Pt, | 4028.7 | 10.2 | Pt, |
| | 4007.8 | 9.6 | Br, | 4039.6 | 10.7 | Ie. |
| 230110 R PEGASI— | | | | | | |
| | 4000.8 | 11.4 | M, | 4024.6 | 11.9 | Ie, |
| | 4000.8 | 11.3 | Pt, | 4028.7 | 12.0 | Pt, |
| | 4006.8 | 11.5 | Ie, | 4029.8 | 12.2 | Br. |
| | 4007.8 | 11.0 | Br, | | | |
| 230759 V CASSIOPEIAE— | | | | | | |
| | 3984.6 | 8.3 | Mi, | 4015.5 | 7.9 | Ro, |
| | 3986.7 | 8.0 | Cy, | 4016.7 | 7.9 | Cy, |
| | 3986.7 | 8.1 | Mi, | 4024.6 | 7.7 | Ca, |
| | 3987.5 | 8.3 | Ro, | 4027.8 | 8.5 | Cy, |
| | 3988.6 | 8.0 | Mi, | 4028.7 | 7.8 | Pt, |

VARIABLE STAR OBSERVATIONS, July 20 to September 20, 1924—Continued.

| Star | J.D. | Est.Obs. | J.D. | Est.Obs. |
|---|---|---|---|---|
| 230759 V CASSIOPEIAE—Continued. | | | | |
| | 3988.6 | 8.4 O, | 4029.8 | 8.3 Br, |
| | 3990.6 | 7.9 Ca, | 4030.6 | 8.2 Du, |
| | 3991.8 | 7.6 Sg, | 4031.2 | 8.0 Ch, |
| | 3992.8 | 7.9 Mi, | 4033.5 | 8.1 Ca, |
| | 3996.6 | 7.8 Ca, | 4033.6 | 8.4 Du, |
| | 3996.6 | 7.9 Mi, | 4035.6 | 8.8 Du, |
| | 4000 8 | 7.2 Pt, | 4038.6 | 8.8 Mi, |
| | 4001.5 | 7.4 Ro, | 4040.6 | 9.0 Du, |
| | 4005.6 | 7.3 Ca, | 4041.6 | 9.1 Mi, |
| | 4011.7 | 7.8 Mi, | 4047.5 | 9.7 Ro. |
| | 4012.6 | 7.8 Ca, | | |
| 231425 W PEGASI— | | | | |
| | 4005 8 | 11.3 Lv. | 4028.7 | 11.1 Mi, |
| | 4007.8 | 11.4 M, | 4028.8 | 10.8 M, |
| | 4019.8 | 11.2 Br, | 4039.7 | 10.6 Br. |
| 231508 S PEGASI— | | | | |
| | 4000 8 | 11.9 Pt, | 4028.7 | 11.9 Pt. |
| | 4025.7 | 12 6 Br, | | |
| 232848 Z ANDROMEDAE— | | | | |
| | 4000.8 | 9.6 Pt, | 4028.7 | 9.5 Pt. |
| 233335 ST ANDROMEDAE— | | | | |
| | 3991.8 | 9.6 Sg, | 4028.7 | 8.6 Pt, |
| | 3993.6 | 9.7 O, | 4028.8 | 9.5 M, |
| | 4000.6 | 9.8 Ca, | 4036.6 | 9.3 O. |
| | 4000.8 | 8.9 Pt, | | |
| *233815* R AQUARII— | | | | |
| | 3914.3 | 7.7 An, | 4028.7 | 10.1 Pt, |
| *233815* R AQUARII—Continued. | | | | |
| | 3996.7 | 9.8 Ca, | 4028.7 | 10.4 Mi, |
| | 3997.5 | 9.8 An, | 4030.7 | 10.6 Ca, |
| | 4000.8 | 9.9 Pt, | 4031.2 | 10.5 Ch. |
| 233956 Z CASSIOPEIAE— | | | | |
| | 3989.8 | 9.7 Wf, | 4029.7 | 10.5 Wf, |
| | 3995.7 | 9.5 Wf, | 4029.8 | 10.4 Br, |
| | 4002.8 | 9.7 Wf, | 4039.6 | 10.7 Ie. |
| | 4021.7 | 10.0 Wf, | | |
| 235053 RR CASSIOPEIAE— | | | | |
| | 3993.6 | 11.3 O, | 4026.6 | 10.6 Ie. |
| | 4012.8 | 10.7 Ie, | | |
| *235209* V CETI— | | | | |
| | 4000.8 | 12.5 Pt. | | |
| 235350 R CASSIOPEIAE— | | | | |
| | 3986.7 | 9.3 Cy, | 4024.7 | 11.4 Cy, |
| | 3994 7 | 9.8 Ca, | 4025.6 | 10.1 Mi, |
| | 4001.7 | 9.9 Mi, | 4033.6 | 11.6 Ca, |
| | 4011.7 | 10.1 Mi, | 4034.7 | 10.4 Mi. |
| | 4012.6 | 10.3 Ca, | | |
| 235525 Z PEGASI— | | | | |
| | 4000.8 | 12.6 Pt, | 4029.8 | 12.2 Br. |
| | 4028.7 | 12.0 Pt, | | |
| 235855 Y CASSIOPEIAE— | | | | |
| | 3987.6 | 10.9 O, | 4021.8 | 11.5 Br. |
| | 3993.6 | 10.9 O, | | |
| 235939 SV ANDROMEDAE— | | | | |
| | 3986.9 | 12.4 Br. | | |

| | July-August | August-September | Total |
|---|---|---|---|
| Observations | 1655 | 1541 | 3196 |
| Stars Observed | .... | .... | 272 |
| Observers | 27 | 25 | 34 |

SUMMARY OF ANNUAL REPORTS.

| Year | Observations | Stars | Observers |
|---|---|---|---|
| 1912 | 6.180 | 175 | 19 |
| 1913 | 12,914 | 200 | 20 |
| 1914 | 14,506 | 255 | 28 |
| 1915 | 14,724 | 282 | 29 |
| 1916 | 11,261 | 290 | 30 |
| 1917 | 15.788 | 332 | 43 |
| 1918 | 16,112 | 380 | 34 |
| 1919 | 8,710 | 352 | 53 |
| 1920 | 9,099 | 395 | 69 |
| 1921 | 15,513 | 386 | 77 |
| 1922 | 16,994 | 372 | 72 |
| 1923 | 17,745 | 441 | 68 |
| 1924 | 19,484 | 450 | 70 |
| Totals | 179,030 | 450 | 270* |

*Approximate number of observers in all the published reports of the A. A. V. S. O.

ANNUAL REPORT OF THE AMERICAN ASSOCIATION OF VARIABLE STAR OBSERVERS, 1923-1924.

| Observer | Initial | 1923 November | 1923 December | 1924 January | 1924 February | 1924 March | 1924 April | 1924 May | 1924 June | 1924 July | 1924 August | 1924 September | 1924 October | Totals |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Allen, P. R. | Al | .. | .. | 3 | 1 | 6 | .. | 30 | 15 | 7 | 20 | 9 | 17 | 108 |
| Ancarani, M. | An | 30 | .. | 34 | 15 | .. | .. | .. | .. | .. | .. | 67 | .. | 146 |
| Aurino, S. | Au | .. | .. | .. | .. | 30 | .. | .. | .. | .. | .. | .. | .. | 30 |
| Baldwin, J. M. | Bl | 231 | 75 | 229 | 170 | 150 | 153 | 153 | 208 | 149 | 252 | 166 | .. | 1936 |
| Barringer, R. | Bi | 6 | 10 | .. | 10 | .. | .. | .. | .. | .. | .. | .. | .. | 26 |
| Bouton, T. C. H. | B | 94 | 202 | 194 | 218 | 85 | 78 | 110 | 115 | 91 | 9 | 82 | 42 | 1320 |
| Brocchi, D. F. | Br | 177 | 91 | 12 | 12 | 33 | 41 | 37 | 45 | 30 | 43 | 64 | 151 | 736 |
| Carr, F. J. | Ca | 104 | 82 | 64 | 71 | 96 | 84 | 115 | 54 | 51 | 111 | 139 | 128 | 1099 |
| Chandler, F. H. | Cd | 12 | 19 | 24 | 21 | 36 | 19 | .. | 6 | .. | 14 | 5 | .. | 156 |
| Chandra, R. G. | Ch | 103 | 144 | 137 | 185 | 146 | 154 | 141 | 173 | 131 | 35 | 62 | 51 | 1462 |
| Chisolm, R. S. | Cm | 3 | .. | 5 | .. | .. | 1 | .. | .. | .. | 9 | 32 | .. | 50 |
| Christie, W. H. | Ct | 39 | 11 | .. | 26 | .. | .. | .. | .. | .. | .. | .. | .. | 76 |
| Cilley, M. | Cy | 18 | 44 | 33 | 62 | 114 | 79 | 103 | 111 | 80 | 56 | 56 | 114 | 870 |
| Clough, Miss I.L.B. | Cg | .. | .. | .. | 5 | 11 | .. | .. | .. | .. | .. | 5 | .. | 21 |
| Cunningham, L.E. | Cu | .. | 65 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 65 |
| Gaebler, H. D. | Gb | 5 | .. | 3 | 2 | 3 | 3 | 2 | 8 | 7 | 4 | 11 | 12 | 60 |
| Godfrey, Dr. C. C. | Gd | 8 | .. | 16 | 10 | .. | .. | .. | .. | .. | .. | .. | .. | 34 |
| Henry, Wm. | Hr | .. | 6 | 9 | .. | .. | 12 | 11 | 13 | .. | 4 | 15 | 32 | 102 |
| Hunter, S. C. | Hu | 20 | 26 | 25 | 25 | .. | .. | .. | .. | .. | .. | .. | .. | 96 |
| Iedema, N. | Ie | 23 | 44 | 74 | 135 | 68 | 78 | 80 | 22 | .. | .. | 47 | 95 | 666 |
| Inglis, W. E. | I | .. | .. | 13 | 10 | 8 | .. | .. | .. | .. | .. | 11 | .. | 42 |
| Jones, E. H. | Js | .. | .. | .. | .. | .. | 2 | 2 | 3 | 4 | 25 | 35 | 37 | 108 |
| Kanda, S. | Kd | 40 | 40 | 56 | 49 | 73 | 113 | .. | 14 | 20 | 27 | 31 | 22 | 485 |
| Kasai, Y. | Ks | .. | .. | .. | 20 | 18 | .. | .. | 12 | .. | .. | .. | .. | 50 |
| Kleis, L. E. | Kl | 226 | 50 | 72 | 28 | 28 | .. | 54 | 42 | 33 | 41 | 62 | 79 | 715 |
| Lacchini, Miss B.R. | Lh | 36 | 29 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 65 |
| Lacchini, G. B. | L | 174 | 103 | 27 | 25 | .. | 54 | .. | 8 | .. | 104 | 18 | 29 | 542 |
| Lytle, Mrs. C. C. | Ly | 34 | 27 | 26 | 22 | 28 | 37 | 35 | 22 | .. | 33 | 44 | 46 | 354 |
| Leavenworth, F.P. | Lv | .. | 50 | 69 | 40 | 44 | 51 | 48 | 32 | .. | 36 | 70 | 60 | 500 |
| McAteer, C. Y. | M | 59 | 10 | 23 | 19 | 19 | 26 | 28 | 53 | 16 | 58 | 69 | 36 | 416 |
| Mitchell, Ezra D. | Mi | .. | .. | .. | .. | .. | .. | .. | .. | 30 | 132 | 175 | 103 | 440 |
| Miyajima, Z. | Mj | .. | .. | .. | 3 | 27 | .. | .. | 13 | .. | .. | .. | .. | 43 |
| Morris, Mrs. M. | Ms | .. | 63 | 42 | .. | .. | .. | .. | .. | .. | .. | .. | .. | 105 |
| Murata, E. | Mt | .. | .. | .. | .. | 5 | .. | .. | 14 | 10 | .. | .. | .. | 29 |
| Nakamura, K. | Nk | 66 | .. | 47 | 33 | 44 | .. | .. | 28 | .. | .. | .. | 12 | 230 |
| Olcott, W. T. | O | 93 | 35 | 17 | .. | .. | .. | .. | 13 | 26 | 28 | 17 | 68 | 297 |
| Parkhurst, J. A. | Pa | .. | 32 | 24 | .. | 16 | 15 | 15 | 12 | .. | .. | 21 | .. | 135 |
| Peltier, L. | Pt | 305 | 272 | 273 | 248 | 257 | 231 | 241 | 236 | 220 | 245 | 266 | 276 | 3070 |
| de Perrot, E. | Pe | 17 | 8 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 25 |
| Pickering, D. B. | Pi | 106 | 82 | 11 | .. | .. | .. | .. | .. | .. | .. | .. | 10 | 209 |
| Rhorer, S. L. | Ro | 32 | 6 | .. | .. | .. | .. | .. | 26 | 31 | 32 | 28 | 6 | 161 |
| Schüller, F. | Sl | .. | .. | .. | .. | .. | .. | .. | 19 | .. | 19 | 35 | .. | 73 |
| Skaggs, J. H. | Sg | 66 | 104 | 60 | 60 | 46 | 67 | 53 | 50 | .. | 32 | 24 | 36 | 598 |
| Smith, W. H. | Sm | .. | .. | .. | .. | .. | .. | .. | .. | .. | 108 | .. | .. | 108 |
| Waterfield, W.F.H. | Wf | 283 | 86 | .. | 62 | 58 | 40 | .. | 94 | 117 | 136 | 141 | 142 | 1159 |
| Yalden, J. E. G. | Ya | 26 | 25 | 32 | 15 | 9 | 21 | 25 | 18 | .. | 13 | 25 | 27 | 236 |
| Yamamoto, I. | Ym | .. | .. | 51 | .. | .. | .. | .. | .. | .. | .. | .. | .. | 51 |
| Young, Miss A. S. | Y | .. | .. | .. | .. | 21 | 13 | .. | 15 | .. | .. | .. | .. | 49 |
| 22 others | | 26 | 17 | 2 | 32 | 10 | 10 | .. | 1 | .. | 11 | 13 | 8 | 130 |
| Total observations | | 2462 | 1858 | 1707 | 1634 | 1489 | 1382 | 1283 | 1495 | 1053 | 1637 | 1845 | 1639 | 19484 |
| Stars observed | | 334 | 315 | 316 | 303 | 288 | —323— | | —325— | | .. | .. | 272 | 450 |
| Observers per month | | 34 | 35 | 28 | 35 | 31 | 25 | 21 | 30 | 18 | 30 | 27 | 25 | 70 |

The following observers contributed to this report: Messrs. Allen "Al", Ancarani "An", Bouton "B", Brocchi "Br", Calvin "Cv", Carr "Ca", Chandra "Ch", Chisolm "Cm", Cilly "Cy", Miss Clough "Cg", Dunham "Du", Gaebler "Gb", Henry "Hr", Iedema "Ie", Inglis "I", Jones "Js", Kanda "Kd", Kleis "Kl", Lacchini "L", Leavenworth "Lv", Mrs. Lytle "Ly", McAteer "M", Mitchell "Mi", Nakamura "Nk", Olcott "O", Parkhurst "Pa", Peltier "Pt", Pickering "Pi", Prentice "Pn", Rhorer "Ro", Skaggs "Sg", Schüller "Sl", Waterfield "Wf", and Yalden "Ya".

It is with deep regret that the undersigned finds it necessary to surrender for the time the duties of Recording Secretary. Miss Florence Cushman, a member of the Association of long standing, and also a member of the staff of the Harvard College Observatory, has accepted these obligations, and the Association is not only to be congratulated for its good fortune in persuading so efficient a person to carry on, but also owes to Miss Cushman its hearty thanks for her generosity. In view of these facts, all future reports should be sent direct to Harvard College Observatory, in company with the reports intended for permanent file at the Observatory.

HOWARD O. EATON, Recording Secretary.

## COMET AND ASTEROID NOTES.

**Baade's New Asteroid.**—The object mentioned in our last issue, as discovered by Baade at Bergedorf on October 23, turns out to be an asteroid with a very eccentric orbit and with its perihelion point just about half way between the orbits of Mars and the earth. The preliminary orbit computed at the Students' Observatory at the University of California makes the period of the little planet about four and a half years. Its range of distance from the earth at opposition is from about 21,000,000 to about 300,000,000 miles. Of course, the preliminary elements of the orbit being subject to considerable error, these figures must be accepted as only approximate.

Two other known asteroids have very nearly the same eccentricity: (719) Albert, $e = 0.540$, (887) Alinda, $e = 0.532$, while that of only one, (944) Hidalgo, is greater: $e = 0.653$.

The following elements and ephemeris, given in the *Lick Observatory Bulletin* Number 357, were computed by Messrs. Thiele, Maxwell and Jacobsen, and Misses Allen and Prescott, of the Students' Observatory of the University of California, from observations on the dates October 27, 30 and November 3.

ELEMENTS OF BAADE'S NEW ASTEROID.

| | | | | | |
|---|---|---|---|---|---|
| Epoch | 1924, Oct. 30.73337 Gr.M.T. | | $\phi$ | 33° 20′ 51″.3 |
| $M_0$ | 6° 59′ 33″.6 | | log $c$ | 9.740139 |
| $\omega$ | 130 49 48.0 | 1924.0 | $a$ | 2.73481 |
| $\Omega$ | 216 17 23.7 | | $\mu$ | 784″.530 |
| $i$ | 26 18 45.8 | | $P$ | 4.523 years |

CONSTANTS FOR THE EQUATOR 1924.0.

$$x = r(9.984515) \sin (\ 74^\circ\ 11'\ 2''.6 + v)$$
$$y = r(9.999818) \sin (343\ \ 44\ \ 0.1 + v)$$
$$z = r(9.421517) \sin (\ 67\ \ 39\ 50.4 + v)$$

EPHEMERIS FOR GREENWICH MEAN MIDNIGHT.

| 1924 | | True α | True δ | log Δ | mag. |
|---|---|---|---|---|---|
| | | h m s | ° ′ ″ | | |
| Nov. | 12.5 | 22 40 27.0 | +3 24 35 | 9.774 | 9.3 |
| | 14.5 | 22 49 04.2 | 2 28 44 | | |
| | 16.5 | 22 57 29.4 | 1 36 35 | 9.796 | 9.5 |
| | 18.5 | 23 05 42.5 | 0 48 10 | | |
| | 20.5 | 23 13 43.6 | +0 03 24 | 9.818 | 9.6 |
| | 22.5 | 23 21 32.6 | −0 37 42 | | |
| | 24.5 | 23 29 09.8 | 1 15 10 | 9.842 | 9.8 |
| | 26.5 | 23 36 35.5 | 1 49 12 | | |
| | 28.5 | 23 43 49.5 | 2 19 55 | 9.867 | 9.9 |
| Nov. | 30.5 | 23 50 52.8 | 2 47 22 | | |
| Dec. | 02.5 | 23 57 45.1 | 3 11 45 | 9.892 | 10.1 |
| | 04.5 | 0 04 27.0 | 3 33 15 | | |
| | 06.5 | 0 10 59.0 | 3 52 01 | 9.917 | 10.2 |
| | 08.5 | 0 17 21.2 | 4 08 10 | | |
| | 10.5 | 0 23 34.2 | 4 21 54 | 9.942 | 10.4 |
| | 12.5 | 0 29 38.7 | 4 33 06 | | |
| Dec. | 14.5 | 0 35 33.8 | −4 42 40 | 9.966 | 10.6 |

The following observations of the planet have come to hand from various sources:

| | G. M. T. | α | δ | Observer | Place |
|---|---|---|---|---|---|
| | h m s | h m s | ° ′ ″ | | |
| Oct. 23 | 7 25.5 | 21 05 16. | +15 28 | Baade | Bergedorf |
| *24 | 6 58.6 | 21 09 59.7 | +14 49 34 | Baade | Bergedorf |
| 25 | 6 18.5 | 21 14 47.60 | +14 11 26 | Mündler | Königstuhl |
| 25 | 8 51.2 | 21 15 17.7 | +14 07 25 | Gonnessiat | Algiers |
| 25 | 8 59.0 | 21 15 31.0 | +14 07 09 | Delporte | Uccle |
| 26 | 6 43 43 | 21 19 46.11 | +13 31 09.7 | Vinter Hansen | Copenhagen |
| 26 | 7 01 47 | 21 19 49.84 | +13 30 40.5 | J. P. M. | Copenhagen |
| 27 | 11 19.0 | 21 25 35.33 | +12 44 07.3 | Delporte | Uccle |
| †28 | 11 22.2 | 21 30 26.1 | +12 04 41 | Merton | Greenwich |
| *29 | 13 56.4 | 21 35 49.2 | +11 21 51 | Bower | Washington |
| †30 | 8 28.0 | 21 39 33.7 | +10 52 08 | Merton | Greenwich |
| *31 | 12 15.0 | 21 45 09.1 | +10 08 10 | Bower | Washington |
| †31 | 14 37 17 | 21 45 05.57 | +10 05 58.5 | Wilson | Northfield |
| Nov. †1 | 14 25 52 | 21 50 22.92 | + 9 27 17.5 | Gingrich | Northfield |
| 3 | 6 36 47 | 21 58 23.45 | + 8 26 13.3 | V. H. | Copenhagen |
| 3 | 6 50 03 | 21 58 26.11 | + 8 25 53.6 | J. P. M. | Copenhagen |
| 4 | 5 58 44 | 22 02 58.99 | + 7 51 20.2 | V. H. | Copenhagen |
| 4 | 6 16 05 | 22 03 02.55 | + 7 50 54.3 | J. P. M. | Copenhagen |

The positions of the asteroid on the dates marked with an * are mean places for the beginning of the year 1924. Those marked with a † are astrographic positions for 1924.0. The others are apparent places.

The asteroid appears to be slightly variable in brightness, the Northfield photographs yielding the following magnitudes, the estimates being based on the Durchmusterung magnitudes of two or three neighboring stars in each case:

| Date | Magnitude | | Date | Magnitude | |
|---|---|---|---|---|---|
| | Wilson | Fath | | Wilson | Fath |
| Oct. 31 | 9.0 | ... | Nov. 7 | 9.3 | 9.4 |
| Nov. 1 | 9.4 | 9.3 | 13 | 9.2 | 9.3 |
| 3 | 9.4 | 9.3 | 18 | 9.6 | [9.5 |
| 4 | 9.3 | ]9.4 | | | |

This estimate of brightness on October 31 was very difficult, the images of the asteroid being round while those of the stars were broken trails.

**Encke's Comet *b* 1924.** — Encke's comet was observed by Merton at Greenwich and Van Biesbroeck at the Yerkes Observatory on the night of July 31. The comet became a very easy object about the middle of October, being visible in bright twilight, according to the writer of "Comet Notes" in *The Observatory* for November, 1924. It was followed up to October 22.

Some of the observed positions which have come to hand are the following:

OBSERVATIONS OF ENCKE'S COMET.

| | α 1924.0 h m s | δ 1924.0 ° ′ ″ | Observer | Place |
|---|---|---|---|---|
| July 31.57729 | 3 24 05.8 | +28 02 37 | Merton | Greenwich |
| 31.86500 | 3 24 53.4 | +28 06 27 | Van Biesbroeck | Williams Bay |
| Aug. 27.54042 | 5 01 14.04 | +34 59 29.3 | Merton | Greenwich |
| Sept. 29.58056 | 9 24 52.62 | +29 14 48.6 | V. H. | Copenhagen |
| 29.59237 | 9 25 00.05 | +29 14 02.1 | J. P. M. | Copenhagen |
| Oct. 9.60135 | 10 53 32.14 | +17 52 17.1 | V. H. | Copenhagen |
| 9.61169 | 10 53 37.67 | +17 51 25.0 | J. P. M. | Copenhagen |

**Comet *c* 1924 (Finsler).** — In the Copenhagen Circular No. 45 the following elements and ephemeris are given, computed by Professor Kobold from observations at Vienna Sept. 20, Copenhagen Sept. 26 and Babelsberg Sept. 30. It will be seen that these elements agree very closely with those which we published last month.

ELEMENTS OF COMET *c* (FINSLER).

$T$ = 1924 Sept. 4.3370 G. M.T.
$\omega$ = 66° 31′.8
$\Omega$ = 80 02.54
$i$ = 120 09.36
log $q$ = 9.60855

From these elements Mr. Jens Johannsen has computed an ephemeris for the next four months. When the comet gets out from line with the sun it will be out in the asteroid belt, three times the earth's distance from the sun.

EPHEMERIS FOR GREENWICH MIDNIGHT ($0^h$ AFTER JANUARY 1, 1925).

| 1924-1925 | α 1924.0 h m | δ 1924.0 ° ′ | log $r$ | log $\Delta$ | |
|---|---|---|---|---|---|
| Nov. 25 | 16 35.0 | —27 10 | 0.2461 | 0.4361 | $11^m$ |
| Dec. 11 | 16 53.0 | —30 15 | | | |
| Dec. 27 | 17 09.0 | —32 56 | 0.3528 | 0.4992 | |
| Jan. 13 | 17 22.7 | —35 28 | | | |
| Jan. 29 | 17 33.4 | —38 01 | 0.4322 | 0.5181 | |
| Feb. 14 | 17 40.0 | —40 41 | | | |
| Mar. 2 | 17 41.0 | —43 34 | 0.4953 | 0.5086 | |
| Mar. 18 | 17 34.7 | —46 38 | | | |
| Apr. 3 | 17 18.8 | —49 41 | 0.5476 | 0.4900 | $13^m$ |

The writer of "Comet Notes" in *The Observatory* for November, 1924, calls attention to a resemblance of the elements of Finsler's Comet to the elements of the comet of 770 which were found by Langier and Hind as follows:

| | Langier | Hind |
|---|---|---|
| $T$ = | 770 June 6.59 | 6.65 |
| $\omega$ = | 93° 52′ | 86° 46′ |
| $\Omega$ = | 90 59 | 88 54 |
| $i$ = | 118 11 | 120 29 |
| log $q$ = | 9.8077 | 9.7801 |

**Comet Finsler *c* 1924.**—The short appearance of this object, faintly visible to the naked eye in the evening sky, and its low altitude above the horizon gave little opportunity for an extensive study of its physical appearance. That it displayed some activity in tail-formation can be seen from the two accompanying photographs made at the Yerkes Observatory (Plate XXXII).

The first one (Fig. 1) was obtained on Sept. 22 with the 24-inch reflector at $13^h 20^m$ G. M. T. The 30 minutes exposure has brought out the fan-like expansion of short rays emanating from the large nucleus, as well as the extension of the main tail, which is cut off by the limits of the plate at 66′ from the nucleus. Before reaching that point, however, the main straight tail, which is in position-angle 75°, appears suddenly bent sideways at 46′ from the nucleus. The axis runs now for about 6′ in position-angle 120°, then comes back to its original direction in line with the nucleus.

The following night a 35-minute exposure was obtained (Fig. 2), with the Bruce telescope, in order to trace the whole extent of the tail ($13^h 18^m$ G. M. T.). It can be followed over four degrees from the nucleus in position-angle 77°. The discontinuity in the tail recorded yesterday now reaches 52′ from the nucleus but it is now in position-angle 35°, which is on the other side of the main axis as compared with the picture taken 24 hours earlier. Beyond this point the long narrow tail begins to widen and spreads to a width of about one degree before fading out of sight. —G. V. B.

## GENERAL NOTES

**Dr. J. M. Schaeberle,** formerly assistant to Professor Watson at Ann Arbor, Michigan, and later a member of the staff of astronomers at the Lick Observatory, died on September 17, 1924, at his home in Ann Arbor, at the age of 71. He was the last survivor of the original staff of the Lick Observatory, having served there from 1888 to 1898. He was a charter member and the first Secretary of the Astronomical Society of the Pacific. He was the first to see, with the great telescope, the companion to Procyon, the existence of which had been predicted from the irregularities in motion as revealed by meridian observations.

**Miss Dorothy Havens,** a graduate of Wellesley college, has been appointed Assistant in the Lick Observatory, the appointment dating from July 1, 1924. (*Pub. A. S. P.*, October, 1924.)

**Mr. H. F. Balmer,** a graduate of the University of Toronto, has been appointed Assistant in the Lick Observatory, to succeed Mr. Hugo Benioff, who has resigned to accept a position at the Mount Wilson Observatory. (*Pub. A.S.P.*, October, 1924.)

**Mr. Piet van de Kamp,** a graduate of Leiden University, who has been an Assistant at the McCormick Observatory, University of Virginia, for the past 18 months, has been appointed Martin Kellogg Fellow, to date from October 1, 1924. (*Pub. A. S. P.*, October, 1924.)

Fig. 1. Sept. 22, 1924, with the 24-inch Reflector.

Fig. 2. Sept. 23, 1924, with the Bruce 6-inch Telescope.

PHOTOGRAPHS OF FINSLER'S COMET *c* 1924, TAKEN AT THE YERKES OBSERVATORY.

**Mr. H. S. Mendenhall** has been appointed Fellow in Astronomy, to date from October 1, 1924, and has been assigned to residence at Berkeley for the present academic year. (*Pub. A. S. P.*, October, 1924.)

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**Mr. J. A. Pearce** has resigned his fellowship in the Lick Observatory to accept a position as Assistant Astronomer in the Dominion Astrophysical Observatory, Victoria, B. C. (*Pub. A. S. P.*, October, 1924.)

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**Mr. C. S. Yue,** holder of the Goewey Fellowship in the University of California, has been assigned to residence at the Lick Observatory for the academic year 1924-25. (*Pub. A. S. P.*, October, 1924.)

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**Thirty-Third Meeting of the American Astronomical Society.**—The following is taken from Secretary Stebbins' "Circular of Information," received just as the last form of this issue of POPULAR ASTRONOMY goes to press:

The thirty-third meeting of the Society will be held in affiliation with the American Association for the Advancement of Science in Washington, from December 30, 1924 to January 1, 1925. This is one of the large quadrennial meetings when the Association and affiliated societies meet in one of the centers, New York, Chicago, or Washington.

Railroad rates from practically all points in the United States will be available at one and one-half fares for the round trip. Each visitor should be sure to ask for a certificate in purchasing his ticket. Return tickets will be validated at the headquarters of the Association in the New Willard Hotel, where also will be located the general registration room.

The headquarters for the Society will be at the Hotel Powhatan, 18th and Pennsylvania Avenue, N. W. Members should write early to the hotel for reservations. The following rates are quoted:

Rooms without bath: single $3.00 to $3.50; double $5.00.

Rooms with bath: single $4.00 to $5.00; double $6.00 to $8.00.

Mail may be addressed in care of the American Astronomical Society, Hotel Powhatan, Washington, D. C.

The tentative program includes a combined session with the American Physical Society on Tuesday afternoon, December 30. On Wednesday, at the invitation of the Superintendent, the Society will hold morning and afternoon sessions at the United States Naval Observatory. Arrangements are being made for a combined session with other societies on Thursday morning, and in the afternoon the Society will probably hold its final session for papers.

An informal dinner for members and their friends will be held Thursday evening. Cost two dollars per plate.

On Friday and Saturday, the American Section of the International Astronomical Union will meet at the building of the National Academy of Sciences. Although the American Section acts as a committee of the National Research Council, its organization is practically in the hands of the American Astronomical Society, and all members attending the Washington meeting are of course invited to remain for the meeting of the Section.

PROVISIONAL PROGRAM.

*Tuesday, December 30, 1924*

At the Hotel Powhatan, 9:30 A. M.
Meeting of the Council.
At the U. S. Bureau of Standards, 2:00 P. M.
Combined session with the American Physical Society.
Address by W. F. G. Swann, retiring vice-president of Section B:
*"The Trend of Thought in Physics."*
Address by Heber D. Curtis, retiring vice-president of Section D:
*"The Equinox of 1950."*
Other papers of common interest to physicists and astronomers.

*Wednesday, December 31*

At the Hotel Powhatan, 8:00 A. M.
Meeting of the Council.
At the U. S. Naval Observatory.
10:00 A. M. Session for papers.
3:00 P. M. Session for papers.

*Thursday, January 1, 1925*

At the Hotel Powhatan.
8:00 A. M. Meeting of the Council.
At a place to be arranged.
10:00 A. M. Combined session with other societies.
3:00 P. M. Session for papers.
At the Hotel Powhatan.
6:00 P. M. Informal dinner.

*Friday, January 2*

At the National Research Council.
9:30 A. M. Meeting of the American Section of the International Astronomical Union.

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**Pressures in the Sun's Atmosphere.**—In the *Astrophysical Journal* for July, St. John and Babcock give the results of their studies on pressure and circulation in the solar atmosphere. Combining their results with some other lines of evidence, they obtain the following values for the pressure at various elevations above the photosphere:

| Elevation | Pressure | |
|---|---|---|
| 275 km | 0.1 | atmosphere |
| 400 | 0.01 | " |
| 5000 | 0.0001 | " |
| 14000 | 0.000,000,000,000,1 | " |

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**The Variable Star RZ Cephei.**—In the Harvard College Observatory Circular 261, a discussion is given of the variability of the star RZ Cephei. The discussion was essentially completed by Miss Leavitt in 1921 and her results are given in this paper by Dr. Luyten with some results of his own study. The remarkable fact is brought out that the observations appear to indicate two marked changes in the period of the star's variation. Prior to 1901 the observations are well represented by a period of $0^d.308668$, while between 1901 and 1915 the period seems to have had the uniform value of $0^d.308624$, and after 1915 the original value of $0^d.308668$. The change of period does not seem to have taken place abruptly but appears to have consumed as many as a hundred periods. The changes occurred between Julian Dates 2415300 and 2415500 and between Julian Dates 2420550 and 2420600.

**New Determination of the Velocity of Light.**— Prof. A. A. Michelson has been making a new determination of the velocity of light. The work was carried out at the Mount Wilson Observatory last summer. The beam of light used traveled from Mount Wilson to Mount San Antonio, a distance of 35.4263 km (approximately 22 miles), and back. The final result of the season's work gives 299,820 km per second as the velocity of light in a vacuum. It is planned to continue the work next summer and use some additional refinements of technique, in order to attempt to bring the accuracy of the value of the velocity down to the accuracy of the value of the distance between the two stations, namely, about two parts in a million.

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**The Eclipse Cycle to which the Solar Eclipse of January 24, 1925, belongs.** — Mr. F. E. Seagrave sends us the following memoranda concerning the series of eclipses to which the total solar eclipse of January 24 next belongs. He says: "January 24, 1925, will be the first time the moon's shadow has passed over any part of Connecticut or Rhode Island (that is, where Connecticut and Rhode Island are now situated) since July 29, 1478."

THE ECLIPSE CYCLE OF THE JANUARY 1925 ECLIPSE.

1. First eclipse of the cycle, a small partial one visible in high southern latitudes on May 27, 933. Moon's mean anomaly 186° 02′ 00″. $Y_0' = -1.517$.

2. First central eclipse of the cycle was an annular one, also visible in high southern latitudes on August 10, 1059. Moon's mean anomaly 165° 52′ 04″. $Y_0' = -0.949$.

3. The middle eclipse of the cycle took place (it was also an annular one) on May 7, 1510. Moon's mean anomaly 94° 27′ 36″. $Y_0' = -0.100$.

4. The series changed from annular to total on June 8, 1564. Moon's mean anomaly 85° 56′ 24″. $l_1 = -.0001$. $Y_0' = +0.125$.

5. Last central eclipse of cycle will take place on March 30, 2033, and will be visible in high northern latitudes. Moon's mean anomaly 12° 37′ 12″. $Y_0' = +0.984$.

6. The series will entirely run out on June 25, 2177. On that day a small partial eclipse will be visible in high northern latitudes. Moon's mean anomaly 350° 13′ 48″. $Y_0' = +1.485$.

7. As the eclipses all take place at the moon's descending node, the series is running north. Life history 1244 years. The duration of totality on the central line is now *increasing* at each recurrence. The January 24, 1925, eclipse will be the third (Saros) return of the famous Spanish eclipse of December 22, 1870.

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**The Bond Astronomical Club.**— A new astronomical club, of interest to the amateur and professional alike, known as the Bond Astronomical Club and named in honor of the first two Directors of the Harvard Observatory, has been recently organized at Cambridge. Their present headquarters are at the Harvard Observatory and already a membership of over one hundred has been attained. Mr. Odin Roberts, of Boston, is President, Mr. G. W. Stoyle, of Boston, is Secretary, Miss Ida M. Cannon, of Cambridge, is Treasurer, and Professor L. A. Brigham of Boston University and Mr. Leon Campbell of Harvard Observatory complete the list of Council members. Eight regular meetings from October to May are contemplated. Professor Frederic Slocum, of the Van Vleck Observatory, Middletown, Conn., lectured at the meeting held October 25, on "The Dawn of Astronomy."

**A Hand-Book of Solar Eclipses,** by Isabel M. Lewis. Published by Duffield & Company, New York. $1.25 net. This little book of 118 pages is written in popular style, and is designed to meet the wants of people whose interest may be excited by the imminence of the Total Eclipse of the Sun on January 24, 1925, one of the few whose tracks cross the northeastern part of the United States. The book, however, deals with the phenomena which may be observed at any total eclipse of the sun and should be interesting to the general reader. It is illustrated with photographs of the solar corona taken at some of the most recent solar eclipses.

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**The Graphic Construction of Eclipses and Occultations,** by William F. Rigge. Published by the Loyola University Press, Chicago.

This is an excellent book, designed especially for amateur astronomers and teachers of astronomy, who may wish to picture to themselves and others the exact relations of the bodies concerned in eclipses and occultations. The construction of a lunar eclipse, as the author says in his preface, "is so simple that nothing but straight lines and circles enter into it." For a solar eclipse but one additional geometrical figure is required, that being the ellipse which is the projection of the diurnal path of the place of observaton as seen from the sun. This, however, can be drawn with ordinary draughting tools. The data needed can be obtained from the annual volume of the *American Ephemeris.*

The processes which the author describes are also valuable to the professional astronomer in checking the results obtained by more tedious, although more accurate, processes of calculation.

The author first explains the method of constructing a lunar eclipse, using as an illustration the total eclipse of January 7-8, 1917. He later shows how to plot any lunar eclipse by the aid of the data given in Oppolzer's *Canon der Finsternisse,* i. e., between the dates 1207 B. C. and 2161 A. D.

In Chapter II he gives Bessel's method of predicting the times of the phases of a solar eclipse, with careful explanation of the method of construction. In the later chapters of the book, the author gives some devices of his own which make the mechanical work comparatively easy.

Chapters III and VII are devoted to graphical methods of predicting the times of occultations of stars by the moon for a single locality, and maps showing these times for the entire area of the earth's surface from which an occultation may be viewed. Such maps have appeared in POPULAR ASTRONOMY from time to time, by courtesy of Professor Rigge, and have been very useful to our readers.

Chapter VIII gives graphic methods of finding the times of rising and setting of the heavenly bodies. At the end of the book is a chapter giving a short bibliography of the subject.

Professor Rigge has had many years of experience as a teacher of astronomy at the Creighton University, Omaha, Nebraska, and knows well how to adapt his instruction to the capacity of his students. We believe that many amateurs will gain instruction and pleasure through the use of this book.